101676

5.0 ENDANGERMENT ASSESSMENT

Reserved

6.0 IDENTIFICATION AND SCREENING OF POTENTIAL REMEDIAL TECHNOLOGIES

6.1 EVALUATION PROCESS

The overall objective of the CERCLA feasibility study process is the identification of the most appropriate, cost-effective[a] solutions for remediation of a site. In accordance with SARA, an emphasis will be placed on remedial technologies that will reduce the toxicity, mobility, or volume of wastes and contaminated materials. SARA requires that EPA select a remedy that utilizes permanent solutions and alternative treatment technologies, or resource recovery technologies, to the maximum extent practicable. This emphasis may result in the recommendation of remedial technologies that will require bench and/or pilot studies prior to final selection.

The major steps of the multiphased approach to the feasibility study process are:

- Identification of general response actions.
- Identification and screening of applicable technologies.
- Bench and/or pilot scale treatability studies for applicable technologies, when necessary.

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[a] Under SARA, Congress has clarified its definition of cost-effective remedial action (Congressional Record, October 3, 1986, page H9102) as follows: "The term cost-effective means that in determining the appropriate level of clean-up EPA first determines the appropriate level of environmental and health protection, and then selects a cost-efficient means of achieving that goal. Only after EPA determines, by selection of applicable or relevant and appropriate requirements (ARARs), that adequate protection of human health and the environment will be achieved, is it appropriate to consider cost-effectiveness."

- Additional phases of the RI and update of screening process, if necessary.
- Development of remedial action alternatives.
- Detailed analysis of the alternatives.
- Summary and comparison of the alternatives.
- Following treatability studies, summary and comparison of recommended alternatives.

This section presents the first steps of the feasibility study for the Southern Maryland Wood Treating site. The assessment addresses the remedial objectives outlined in subsection 6.2, and considers information concerning the source and site characteristics available from Phase I and II of the remedial investigation. Phase III RI activities which include additional sampling and analysis efforts and the Public Health Evaluation/ Environmental Assessment are recommended in Section 9.0 of this document. The REM II team and the USEPA have discussed the scope of Phase II RI activities and are presently developing a formal scope of work. The results of these activities may impact the discussions of the remedial action alternatives presented in this report.

Subsection 6.3 identifies the general response actions and associated remedial technologies applicable to the site. The initial screening of potential remedial technologies, based on Phase I and II RI information, follows in Subsection 6.4. The technologies are screened to eliminate those that have limitations for specific chemical constituents and site characteristics, or have inherent technological limitations. Further screening is not performed at this time as the additional data to be obtained during Phase III activities will have a significant impact on the feasibility of many technologies.

6.2 REMEDIAL ACTION OBJECTIVES

General, conceptual-level remedial action objectives for the Southern Maryland Wood Treating site are presented herein. These objectives are based on the results of Phase I and II of the RI and will be refined following completion of the Phase III RI and the public health assessment.

Remedial action alternatives are long-term, permanent remedies that will minimize or prevent hazardous substance releases from the site. This is accomplished, preferably through permanent treatment and/or destruction of contaminants at the site. The objectives of proposed remedial actions are to:

- Reduce or eliminate the organic contamination present in sediments in the pond and in the tributaries to appropriate cleanup levels and prevent off-site migration of contaminants via sediment migration pathway.
- Reduce or eliminate organic contamination from site soils to appropriate cleanup levels.
- Reduce or eliminate the organic contamination present in surface water and in the shallow ground water aquifer, in the area between the process area and the pond, to appropriate cleanup levels, through implementation of soils/sediment and ground water remediation.
- Reduce or eliminate the threat from existing contaminated buildings, storage/process tanks and process equipment through demolition/remediation of these and any associated organic contaminant contents.

6.3 GENERAL RESPONSE ACTIONS

A number of general response actions have been identified for the Southern Maryland Wood Treating site, based on the information and data presented in Sections 1 through 4 of this report. These response actions, the associated remedial technologies, and site problem areas to be addressed are presented in Table 6-1. The identified response actions and technologies include source control and management of contaminant migration measures, as well as "no action." The no action response alternative will be used as a baseline against which other measures will be evaluated.

Waste materials at the Southern Maryland Wood Treating site consist mainly of soils and sediments contaminated with PNAs and as a result, some treatment technologies are considered that will primarily address PNAs. Other si contaminants, inc ding other organics such as phenols and acid extractable organi , are also considered in the screening process. Where not discussed, it is assumed that the technology under consideration will address these other constituents along with PNAs. The exception is for dioxins; the screening discussions specifically point-out if the technology applies to dioxins.

The applicability of the technologies to each of the site problem areas (surface soils, subsurface soils, sediments, ground water, surface water, and buildings/tanks/process equipment) is addressed. These site problem areas were discussed in Section 4.0 of this report and are briefly summarized as follows:

- <u>Surface soils</u> - Consist of all contaminated (at levels above cleanup action levels) at depth intervals between 0-2 feet on the site within the site property boundary line.
- <u>Sediments</u> - Consist of the contaminated soils and sediments (above cleanup levels) in the on-site pond and the east and west tributaries.
- <u>Subsurface soils</u> - Refers to contaminated (at levels above cleanup action levels) soils below the site surface soils; the majority of subsurface contamination is in the area south of the process area.

TABLE 6-1

GENERAL RESPONSE ACTIONS AND ASSOCIATED REMEDIAL TECHNOLOGIES

General Response Action	Potential Remedial Technologies to be Screened	Site Problem(s) Potentially Addressed by Technologies
No action	Monitoring Upgrade site security	Surface soils Sediments Subsurface soils Surface water Ground water Buildings/tanks
Surface Diversion and Collection	Regrading, revegetation and diversion Ditches and interception trenches Sedimentation ponds and basins	Ground water Surface water Surface runoff
Capping and Ground Water Containment Control	Capping techniques • Synthetic membranes • Low permeability soils • Surface sealing - Soil/bentonite admixtures - Asphalt/concrete Ground water containment controls • Containment - slurry walls - grout curtains - sheet piling - bottom sealing (directional grouting) • Interception (trenches, ditches, and drains) • Ground water pumping	Surface soils Ground water Subsurface soils
Complete or Partial Removal	Excavation/dredging • Soils • Sediments • Building/tank removal	Surface soils Subsurface soils Building/tanks/ process equipment

TABLE 6-1
(Continued)

GENERAL RESPONSE ACTIONS AND ASSOCIATED
REMEDIAL TECHNOLOGIES

General Response Action	Potential Remedial Technologies to be Screened	Site Problem(s) Potentially Addressed by Technologies
In Situ Treatment	Biological ● Biodegradation/ bioreclamation Chemical ● Soil flushing Physical ● In situ adsorption ● Supercritical extraction Thermal ● In situ vitrification	Surface soils Subsurface soils Surface water Ground water
On-Site Treatment	Thermal ● Incineration ● Pyrolysis ● Oxidation Solidification/ stabilization ● Cement/pozzolanic ● Thermoplastic Microencapsulation Chemical/Physical ● Soil washing/extraction ● Macroencapsulation/over-packing ● Chemical oxidation/ reduction ● Activated carbon absorption ● Ion exchange ● Membrane separation	Surface soils Sediments Subsurface soils Ground water Surface water Washing Extracts Sediment dredging water Tank wastes Dioxins
On-Site Treatment (Continued)	Biological ● Land treatment/composting ● Aerobic treatment ● Anaerobic treatment	

TABLE 6-1
(Continued)

GENERAL RESPONSE ACTIONS AND ASSOCIATED
REMEDIAL TECHNOLOGIES

General Response Action	Potential Remedial Technologies to be Screened	Site Problem(s) Potentially Addressed by Technologies
Off-Site Treatment	Thermal ● Incineration Biological ● Aerobic treatment ● Anaerobic treatment Chemical/Physical ● Soil washing/extraction ● Chemical oxidation/ reduction	Surface soils Sediments Subsurface soils Washing extracts Sediment dredging water Tank wastes Dioxins
Off-Site Disposal	RCRA landfill	Surface soils Sediments Subsurface soils Tank wastes Buildings/tanks
On-Site Disposal	On-site RCRA landfill	Surface soils Sediments Subsurface soils Tank wastes Buildings/tanks Dioxins

- Surface Water - Refers to the surface water and surface run off (contaminated at levels above clean-up action levels) in the on-site pond and the west tributary.

- Ground water - Refers to the shallow ground water aquifer (contaminated at levels above cleanup action levels) in the area between the process area and the on-site pond.

- Buildings/tanks/process equipment and tank wastes - Refers to the office, storage and former process buildings, storage and process tanks, and any associated process or other equipment and their contents (contaminated at levels above cleanup action levels) on-site.

6.4 SCREENING OF POTENTIAL REMEDIAL TECHNOLOGIES

6.4.1 SCREENING PROCESS

The objective of this screening is to initially identify the remedial technologies best suited for further consideration in developing remedial alternatives for the Southern Maryland Wood Treating site. The focus of the screening process is to eliminate technologies, based on information obtained from Phase I and II of the RI, which are not feasible because they may prove difficult to implement or have severe limitations which would prevent achievement of the remedial objectives. The technologies are considered according to their technical feasibility in relation to site and waste characteristics, and applicability to the problem areas of the site as identified in Section 4.0.

Potential remedial technologies will be screened using the following process. First, a brief description of the technology is presented with a discussion of its potential application to site problem areas. Then a discussion of the technical reliability (technology development, performance, and reliability) and implementability in relation to site, waste, and technology characteristics is presented. The technologies are also screened for their suitability to the site according to other considerations such as environmental, public health and institutional. A recommendation is then made to retain or eliminate the technology for further consideration based on the criteria described.

6.4.2 TECHNOLOGY SCREENING

No Action Options

No Action

Description -- Under the no action alternative, no remedial measures would be implemented at the Southern Maryland Wood Treating site. This would mean that surface water flow through areas with contaminated sediments would continue unabated via the pond and other site drainage pathways. In addition, ground water contact with on-site contaminated subsurface soils would continue unabated and ground water flow and its discharge into the on-site pond and off-site towards the tributaries and its potential for contaminant transport would continue to be enhanced by surface infiltration. Contaminated surface soils would remain uncontrolled on-site allowing for possible human/wildlife exposure/contact or contaminant migration through surface transport. Also, contaminated buildings, tanks and process equipment would remain in place allowing for possible human/wildlife exposure/contact.

No monitoring of contaminant concentrations in surface water or ground water would be performed and no action would be taken to control downgradient migration of contaminants.

<u>Areas of Site</u> -- This technology is applicable to all areas of the site.

<u>Technical Considerations</u> -- The nature of this technology warrants no discussion of technical considerations.

<u>Other Considerations</u> -- The no action alternative does not address the remedial objectives or the potential threats to the environment or public posed by the site. An existing chain link fence around the site and wooded areas surrounding some of the site would restrict the amount of human/wildlife contact with the contaminated areas. However, the retail business presently active at the site permits unrestricted access by personnel working at the site or obtaining services from the retail operation. In addition, existing contaminant concentrations in and south of the on-site pond may pose a threat to resident wildlife. Unfavorable public reaction can be anticipated because further contamination of off-site areas, and contamination of downstream surface waters, including the west nd east tributaries and MacIntosh Run may potentially result without remedial measures. This alternative has no associated capital costs or operating costs.

<u>Recommendations</u> -- As a result of the potentially adverse environmental and public factors, this technology will be eliminated from further consideration.

No Action With Security Upgrade and Monitoring

Description -- For this alternative, no remedial activities would be performed. However, existing site security would be upgraded and surface water and ground water monitoring would be implemented in areas downgradient of the site along potential pathways of migration to and along the east and west tributaries. Site security would be upgraded by the installation of fencing with 24 hour per day security gates to restrict routine direct contact of humans and wildlife with the contaminated areas on-site. The potential for human and wildlife exposure to off-site contaminated sediments would continue. Monitoring would consist of long-term periodic sampling and analysis of ground water and surface water and/or sediments to provide information for tracking the movement of contaminants from the site. Remedial response actions could then be implemented in the event contaminant concentrations further threaten public health and/or the environment.

Areas of Site -- This technology is applicable to all areas of the site.

Technical Considerations -- This technology can be implemented easily with commonly used construction and sampling techniques.

Other Considerations -- No action with upgraded security and monitoring will restrict access to contaminated on-site areas and establish a measure of human health and environmental protection by providing an "early warning" if and when area drinking water supplies and surface-water resources are threatened. This technology has few associated capital costs and nominal operating and maintenance costs.

Recommendations -- This technology will be retained for further consideration.

Diversion and Collection

Description -- In general, diversion and collection measures use surface management controls to divert surface water runon, enhance surface water runoff, and minimize potential erosion and sediment transport, as shown in Figure 6-1. By enhancing runoff, infiltration into contaminated soils is reduced, and as a result, leachate generation and contaminant transfer to ground water is reduced. Surface management controls include site grading, surface water diversions (diversion ditches, dikes, berms), revegetation, and sedimentation controls.

Because of past practices, most of the on-site surface soils are exposed. These site practices have also resulted in the existence of the pond, which presently receives on-site ground water discharge and surface water runoff. A significant environmental aspect of this pond is that it is part of the transport pathway for contaminated surface soils, sediments, and contaminants from the subsurface soils south of the process area to the west tributary. Various diversion and collection controls are screened in detail below.

Areas of Site -- Diversion and collection techniques are potentially applicable directly to the on-site sediments and surface soils, and indirectly to the shallow ground water.

Regrading, Revegetation, and Diversion

Description -- Surface regrading and revegetation will promote controlled runoff, enhance evapotranspiration, and reduce potential soil erosion on-site. When used in conjunction with

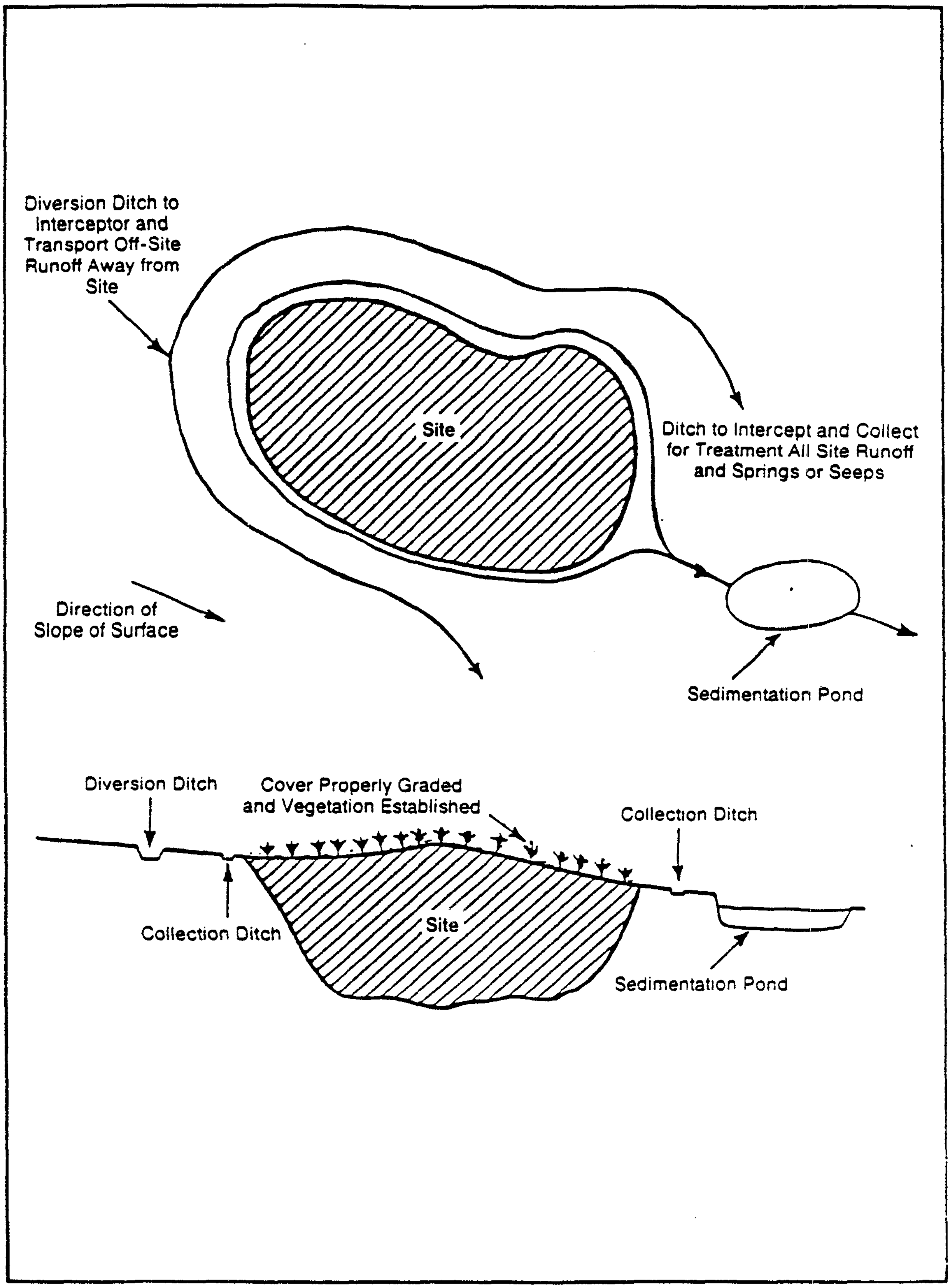

FIGURE 6-1 SURFACE MANAGEMENT CONTROLS

diversion ditches/swales or dikes/berms, site grading can effectively isolate the contaminated area from surface water runon and excessive infiltration by channeling and diverting the surface water flow.

Technical Considerations -- This technology utilizes common engineering and construction practices. Maintenance and repair of the system are required to maintain peak performance.

Other Considerations -- Diversion of urface water through regrading, revegetation, and construction of drainage ditches reduces or eliminates surface water runon to the contaminated areas, promotes surface water runoff and reduces infiltration of water into the subsurface which minimizes contaminant transport to ground water. This technology also minimizes erosion and subsequent damage to a cover/cap system, and the technology itself does not result in any health or environmental hazards.

Certain performance levels for surface management are required under RCRA; however, numerous methods are available for determining design characteristics to meet these requirements. The capital costs for this technology are re tively low. Costs are dependent on volume of soil moved and lining materials, if required. Operation and maintenance (O&M) costs are proportionally higher for this technology to maintain satisfactory performance.

Recommendations -- The surface management technologies will be retained for further consideration. This technology will likely be used in conjunction with other remedial responses.

Sedimentation Basins and Ponds

Description -- Sedimentation basins and ponds are used to collect and control suspended solids that are entrained in stormwater runoff. A sedimentation basin is constructed by placing an earthen dam across a drainage channel or excavating and installing a controlled water discharge.

The use of collection systems can accomplish the following:

- Downgradient temporary storage for testing of surface runoff.
- Downgradient settling of sediment prior to discharge.
- Control or elimination of surface runoff.
- Upgradient collection of potential surface runon.

Technical Considerations -- This technology utilizes common engineering and construction practices. Sedimentation basin designs would have to take into account the amount of stormwater runoff expected to provide sufficient residence time. Geotextile silt fencing could be utilized as a temporary measure for controlling transportation of sediments off-site via the pond and the tributaries.

Other Considerations -- Uncontrolled erosion can adversely affect on-site and off-site waters, and sediment buildup in the surface-water system can have an adverse environmental impact. This technology would impede this uncontrolled erosion and the technology itself does not cause any health or environmental hazards. No institutional obstacles are apparent. Capital and O&M costs are similar to diversion technologies.

Recommendations -- The collection technologies will be retained for further consideration. This technology does not reduce/ eliminate source or migration pathways but would be used in conjunction with other remedial responses.

Capping And Ground Water Containment/Controls

Capping Techniques

Description -- In general capping techniques are desig to minimize infiltration of precipitation through contaminated soils, and thereby reduce generation of leachate and/or contaminant transport to ground water. They also prevent erosion and direct contact with contaminated surface soils, and therefore control contaminant migration via air and surface water/sediment pathways. Capping can be accomplished with a wide variety of materials. These various materials and techniques are screened in more detail in the following paragraphs, according to the following classes:

- Synthetic membranes.
- Low permeability soils.
- Soil admixtures (surface sealing).
- Asphalt or concrete (surface sealing).
- Multilayer cover system.

Areas of Site -- Capping techniques are potentially applicable directly to surface soil areas underlain by subsurface soils and sediments.

Technical Considerations -- Generally, this technology can be implemented easily with proven construction techniques, dependent on the materials used and the site characteristics. Regrading of the cover material to promote drainage is required prior to cap installation. There could be problems associated with maintaining the cap in areas where activity would continue on-site.

Other Considerations -- Capping will facilitate a measure of human health and environmental protection by minimizing or mitigating contamination migration. Cap designs must address the RCRA performance standards for landfill closure. There are no apparent institutional obstacles to capping. The costs differ widely, depending on materials (type and availability), and design parameters (to reflect site specific characteristics). O&M costs involve inspection and maintenance.

Recommendations -- This technology will be retained for further consideration. Specific material and technique recommendations are discussed in the paragraphs that follow. This technology would likely be used in conjunction with other remedial responses that reduce/eliminate contaminant source or migration pathways.

Synthetic Membranes

Description -- Use of synthetic membranes as capping materials includes those made of polyvinyl chloride, chlorinated polyethylene, high, medium, or low density polyethylene (HDPE, MDPE, LDPE), or rubber.

Technical Considerations -- Major factors associated with the successful use of synthetic membranes are selection of the proper membrane material for the desired application, proper seaming and placement to prevent tearing, and protection against weathering or root penetration. The synthetic membranes have highly desirable characteristics such as extremely low permeabilities and are readily available. The major limitations of synthetic membranes are their potential for failure due to puncturing, tearing, or weathering, and that their long-term integrity does not provide a permanent cap. Regrading of the cover material to promote drainage is required prior to cap installation.

Problems may be encountered with constructing a "complete" effective cover if retail operations continue on-site and buildings remain in place. There could also be problems with the integrity of the cap in traffic areas at the site. However, typically synthetic caps are covered with soil, and if so the cover can be designed to carry traffic without injury to the cap.

Other Considerations -- Synthetic membranes are used because in some applications, these materials may offer substantial cost benefits over other materials, i.e., low permeability soils and admixtures. This is particularly true where adequate local supplies of suitable low permeability soils are unavailable. Synthetic membranes are easily available and have extremely low permeabilities to effectively prevent of precipitation.

Recommendations -- This technology will be retained for further consideration.

Low Permeability Soils

Description -- The term "low permeability soils" refers to clays and other fine-grained soils that, when compacted, consistently maintain an in situ permeability of 10^{-6} cm/sec (RCRA definition of low permeability) (0.1 foot/year) or less. Low permeability soils must be of adequate strength to maintain the cap system's integrity and performance in terms of stability and permeability. The technology is implemented by preparing the site to achieve proper grades and then placing the compacted low permeability soil cover over the graded surface. The cap can then be covered by a clean soil layer, followed by topsoil and revegetation.

Technical Considerations -- A key advantage to using compacted low permeability soils is that they are a natural material (materials are adapted and/or have long term existence in the local environment) and may be considered more durable in the long term. In addition, no joint seaming is required. Clay and low permeability soils of adequate clay content are to some extent "self-healing" and can be repaired via placement of additional clay/soil, if damage occurs.

Problems may be encountered with constructing a "complete" effective cover if retail operations on-site continue and buildings remain in place. The present deteriorated condition of the buildings and possible presence of contamination in/on buildings could allow for exposure to and/or migration of contaminants. There could also be cap integrity and maintenance problems in traffic areas on-site.

Other Considerations -- A compacted cap of this material is commonly used as a final cover system to reduce leachate generation by minimizing infiltration. Preliminary information from the RI indicates that local supplies of native low permeability soils, especially those composed of predominantly clay particles, may be readily available in sufficient quantities in the area of the Southern Maryland Wood Treating site.

Recommendations -- This technology will be retained for further consideration.

Soil Admixtures

Description -- A low permeability soil admixture can be placed as the cap layer in a multilayer cover system or a single layer cap system similar to a clay cap. Soil and bentonite admixtures are most commonly used and incorporate a combination of natural and processed bentonite.

These admixtures can replace a natural low permeability soil (i.e., clay) layer when appropriate native soil deposits are not available or cannot be used cost effectively. Soil/fly ash/lime or soil/fly ash/lime/kiln dust admixtures may be used as alternatives to soil and bentonite admixtures. The process typically involves a geotechnical assessment of available soils and determination of the optimal mixture. The bentonite is placed and "admixed" with the soils, and the mixture is uniformly spread and compacted. The bentonite, after proper hydration, expand to fill the void spaces within the soil layer.

Technical Considerations -- Soil and bentonite admixtures are gaining acceptance in field construction applications. Because clay is not always readily available locally, there are several processed bentonites being marketed; some contain additives to reduce the potential for chemical attack by contaminated materials. Soil admixtures require special installation procedures because of the mixing of materials required before installation of the cap. Also, the soil and bentonite layer would require a granular soil cover that would be regraded prior to cap construction. This would promote drainage and minimize direct contact of the soil and bentonite mixture with the contaminated materials.

Problems may be encountered with placing and maintaining a completely effective soil admixture cover if site retail operations continue, road/access to retail operations would have to be built over the cap and buildings remain in place. The present deteriorated condition of the buildings and possible presence of contamination in/on buildings could allow for exposure to and/or migration of contaminants.

Other Considerations -- Because of the special installation procedures, soil admixtures may be costlier than alternative materials.

Recommendations -- This technology will not be retained for further consideration on the basis of comparison to natural clay soils, which should be available locally and, as equally effective.

Asphalt or Concrete

Description -- Asphalt or concrete can be used on a surface as an effective means to control surface infiltration and soil erosion. This technology employs commonly used construction techniques.

Technical Considerations -- Difficulties associated with placement and maintenance of a concrete cap can reduce its efficiency. Present retail operations and the presence of the buildings on-site would prevent placement of complete/effective cap. Long-term effects of property use, differential settlement, sun aging, creep and subgrade movements, and possible freeze/thaw damage could combine to reduce the effectiveness of the cap and damage the integrity of the asphalt or concrete cap. Concrete is a proven construction material however, in this application any types of cracks or injury to the concrete will result in failure of the material as an effective cap; it is anticipated that there would be frequent maintenance required for a concrete cap. However, asphalt may be very effective as a cap material, assuming retail operations are to continue, in storage or high-traffic areas, as compared to a clay or synthetic cap, and would be easier to maintain than concrete.

Recommendations -- Because of the questionable long-term integrity of a concrete cap, this technology will not be considered further. The asphalt cap technology will be retained for further consideration, only for limited use based on its potential application in high-traffic areas of the site.

Multilayer Cover System

Description -- The multilayer cap system represents a cover technology that is gaining widespread use as an infiltration control strategy for waste containment or in-place closure. A typical multilayer cap system, as shown in Figure 6-2, consists of the following three layers:

- Upper soil layer - A topsoil and native soil layer, typically placed to a thickness of about 12 to 24 inches. This layer serves to support vegetation, provide a cover for the drain layer and divert surface runoff, and offers partial freeze/thaw protection to the underlying cap layer.
- Middle drain layer - A graded layer of porous flow zone material (i.e., sand or gravel) or a geogrid that acts as a drainage medium. A sand or gravel layer is typically placed to a thickness of about 18 inches.
- Cap layer - A compacted layer of fine-grained soils of low permeability designed to divert infiltration that has percolated through the upper soil layer. This cap layer is typically placed to a thickness of about 18 to 24 inches.

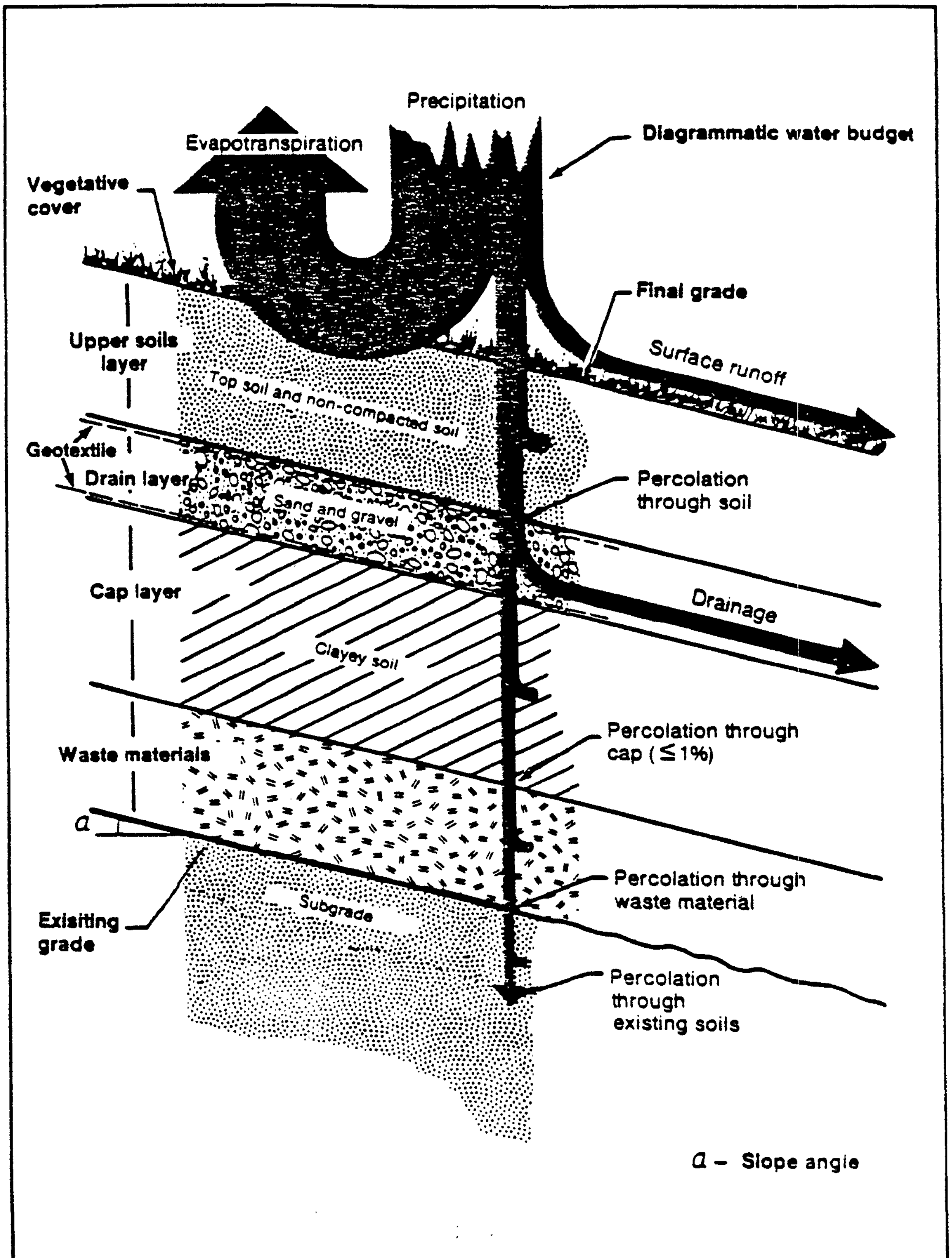

FIGURE 6-2 TYPICAL MULTILAYER CAP SYSTEM PROFILE

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Technical Considerations -- There are several advantages of the multilayer cover system compared to standard native soil cover, including:

- A drain layer that diverts additional percolating water so that it does not eventually contact the underlying contaminated soils.
- Minimized slumping of the topsoil and upper soil layers.

Multilayer cover systems can typically divert greater than 90 percent of the precipitation falling on a site. A long-term effective solution could be expected because the cover is constructed of natural materials.

Problems may be encountered with placing a "complete" effective multilayer cover if site operations continue and buildings remain in place, for reasons as described previously for other cover systems. There could also be problems with the long-term integrity of the cap in the high-traffic areas of the site.

Other Considerations -- The multilayer cap system performs the basic functions of minimizing infiltration into the waste site, directing percolation away from the site, and providing a final cover for the site (including growth media for vegetation), therefore limiting direct contact pathways for humans and wildlife.

Recommendations -- Due to the advantages offered by a multilayer cover system, this technology will be retained for further consideration.

Summary of Capping Recommendations

As a result of the screening of capping technologies, soil admixture and concrete caps have been eliminated from further consideration. Synthetic membrane, low permeability soil, and asphalt caps and multilayer cover systems have been retained.

Ground Water Containment Techniques

Description -- Ground water containment technologies are subsurface control measures designed to control ground water flow and contaminant migration. The primary objective of these measures is to redirect the flow of ground water around a contaminated site and/or contain contaminated ground water within a specific region.

Ground water can be contained or diverted by establishing slurry walls, grout curtains, or other physical low permeability boundaries(sheet piling, bottom sealing/directional grouting). Such boundaries are generally composed of soil/bentonite mixtures and are constructed in place. Such subsurface walls and curtains must be keyed at least three feet into the existing low permeability clayey/silt layer to ensure that the heavier-than-water contaminants do not migrate under the barrier. Containment techniques are sometimes used in conjunction with ground water collection and treatment systems.

Areas of the Site -- Ground water containment techniques are potentially applicable to the area of the site between the process area and the pond where contamination of the shallow aquifer system is evident due to the subsurface soil contamination.

Technical Considerations -- Most ground water containment techniques are well proven and can be implemented using conventional and/or developed construction techniques. It is anticipated that a subsurface wall or curtain could be tied at least three feet into the clayey silt layer (exhibiting permeabilities less than $2x10^{-6}$ cm/sec) that is evident on-site at depths of approximately 20 to 30 feet below ground surface. Additional geotechnical testing of this layer is recommended during RI Phase III to better evaluate the technical feasibility of using this clay and silt layer for ground water containment. Contingency measures may need to be implemented for installation of a wall/curtain because of the high ground water table and the loose to medium nature of the sand layer (above the clayey silt layer). The fine sands encountered on-site could be used as backfill to construct a slurry wall. These sands would be mixed with bentonite to obtain the consistency and permeabilities desired.

Recommendations -- This technology is retained for consideration with capping techniques and would be used in conjunction with other technologies.

Interception Trenches, Ditches, And Drains

Description -- Interception trenches, ditches, and drains are used to prevent migration of contaminants by passively collecting the ground water for removal and/or treatment. This is accomplished by the construction of a series of trenches, ditches, or subsurface graded "french" drains that intercept and collect ground water.

High permeable materials (i.e., gravel bed) are often used in the trenches or as part of a subsurface drainage system to convey flow to a collection sump. Subsurface drains essentially function like a closely-spaced line of ground water extraction wells.

Areas of the Site -- These ground water collection techniques are potentially applicable to the shallow aquifer in the area of the site between the process area and the pond where ground water contamination is evident due to the subsurface soil contamination.

Technical Considerations -- This technology utilizes common engineering and construction practices. Because of the sandy nature of the soils, and low shear strength under saturated conditions, excavation and maintenance of an open trench may be difficult without contingency measures (bracing or shoving). Also, there may be problems with clogging of the high permeable materials due to the presence of "sinkers" or "pure product" contaminants in the ground water. Ground water containment (i.e., slurry wall) may have to be used in conjunction with the interceptor trenches/drains to control and direct the flow of the contaminated ground water.

Other Considerations -- Uncontrolled flow of contaminated ground water can adversely affect downgradient receptors. This technology would impede this uncontrolled migration and itself does not cause any health or environmental hazards. No institutional obstacles are apparent. Capital and O&M costs are similar to diversion and collection technologies, however can be higher if installation maintenance problems are encountered.

Recommendations -- The ground water collection technologies will be retained for further consideration. This technology would have to be used in conjunction with other remedial responses to treat the contaminated ground water that is removed from the aquifer and address the subsurface soil contamination to prevent continued ground water contamination.

Ground Water Pumping

Description -- Ground water pumping is used to prevent migration of contaminants by controlling the ground water flow system. This is accomplished by the construction of a series of pumping recovery wells that are screened in the aquifer of concern. The ground water can then be treated and returned through injection wells and/or discharge to surface waters, or taken off-site for treatment.

Areas of the Site -- Ground water pumping is potentially applicable to the shallow aquifer in the area of the site between the process area and the pond where ground water contamination is evident.

Technical Considerations -- This technology utilizes common well installation practices. Howev , site conditions consist of a contaminated shallow aquifer characterized by relatively low hydraulic conductivities, and limited saturated thickness. The low permeabilities of the fine sand layer (less than $3x10^{-5}$) are indicative of low ground water flow velocities. Because of these site hydraulic conditions it may be difficult to control ground water flow and contaminant migration by pumping. Several pumping wells placed relatively close together would be required to recover the ground water contaminants. Large numbers of wells in this type of aquifer would present maintenance problems. It is anticipated that selected well points could be used for control/ removal of ground water in localized areas on-site. Ground water containment (i.e., slurry wall) may have to be used in conjunction with the pumping wells to control and direct the flow of the contaminated ground water.

Other Considerations -- Uncontrolled flow of contaminated ground water can adversely affect downgradient receptors. This technology, if implemented successfully, would impede this uncontrolled migration and itself does not cause any health or environmental hazards. No institutional obstacles are apparent. Capital and O&M costs are standard for shallow well installation (similar to trenching), however can be higher if maintenance problems are encountered.

Recommendations -- Ground water pumping will be retained for further consideration and would be used in conjunction with other technologies (i.e., with slurry wall).

Complete or Partial Removal

Excavation/Dredging

Description -- Removal technologies involve standard excavation procedures to remove contaminated materials from site areas. Removal of sediments can also involve dredging or suction techniques. At the Southern Maryland Wood Treating site, the maximum volume of material requiring excavation is dependent on the recommended cleanup level to be determined by the public health assessment. Partial removal would be targeted for "hot spots" (i.e., highly contaminated soils associated with the gross subsurface contamination), while some surface soils may be treated in place. This technology is considered as a remedial activity only in conjunction with off-site disposal and/or treatment technologies.

Areas of Site -- This technology can be applied to most problem areas of the site, including surface soils, subsurface soils, and materials from storage tanks. Complete or partial removal of contaminated sediments from the pond and the tributaries would also be considered under this technology.

Technical Considerations -- Excavation can be accomplished with commonly used construction equipment and techniques. Contingency measures are required for excavation of subsurface soils that are in the water table. Some problems may be encountered in the areas downstream of the pond because of the difficulty involved with access to and working in an environmentally-sensitive area. Removal of sediments from the pond and flowing streambeds may require dredging or vacuuming techniques. Use of these procedures result in contaminated water as a by-product, which will require treatment prior to discharge to the tributaries. Treatment techniques are available, including ultrafiltration, sedimentation, and carbon adsorption.

Removal of contaminated materials will not be possible in close proximity or below the existing site buildings without removal of the buildings.

Other Considerations -- A major advantage of this technology is that the source of contamination (to action levels) will be removed. Removal of the contamination source will benefit the local environment in the long term and minimize potential threats to public health emanating from the site. However, if this material is transferred to another site without prior treatment, future problems could result.

There are some restraints on complete removal. Because of the large surface area under consideration, excavation activities would require careful grading and may result in surface runoff that requires monitoring and collection, and sediment control measures. Also, surface runoff must meet the state water quality standards. There are potential problems of disruption or severe damage of the tributary areas associated with sediment removal. Additionally, removal activities may result in air emissions (primarily dust) and would require compliance with the National Ambient Air Quality Standards (NAAQS) of the Clean Air Act. Some sediments and/or subsurface soils may require dewatering and/or stabilization prior to off-site disposal.

The cost of this technology is relatively high. Removal volumes, health and safety requirements, the physical state of the contaminated material, and the need to backfill after removal will all add to the total cost.

Recommendations -- Complete or partial removal will be retained for further consideration.

Building/Tank Removal

Description -- Removal of buildings and abandoned process equipment and storage tanks involves conventional demolition procedures to tear down and remove structures. This technology is considered as a remedial activity only in conjunction with off-site disposal and/or treatment technologies.

Areas of Site -- This technology can be applied to storage tanks, process tanks and vessels, and buildings at the site.

Technical Considerations -- Building and tank removal can be accomplished with commonly used construction equipment and techniques. Contingency measures (i.e., for health and safety) will be required for handling of contaminated materials where necessary. Decontamination of some structures may be necessary prior to disposal. This will result in decontamination fluids as a by-product, which will require treatment and/or disposal. Removal/treatment of contaminated materials will not be possible in close proximity or below the existing site buildings without removal of the buildings.

Other Considerations -- A major advantage of this technology is that contaminated or potentially contaminated buildings, tanks and equipment that remain accessible will be removed. Removal of these structures will minimize potential threats due to human/ wildlife exposure to the contaminants from contact with the buildings and tanks.

Cost is dependent on the amount of buildings and tanks to be removed, health and safety requirements, the amount requiring decontamination, and the type of disposal (i.e., municipal or RCRA landfill).

Recommendations -- Building and tank removal will be retained for further consideration.

In Situ Treatment

Description -- In situ treatment techno gies offer an alternative to excavation, removal, treatment, and disposal of contaminated materials and can include thermal, biological, chemical, and physical processes. These technologies are applied in place at the source and rely on the use of biological or chemical agents, or physical or thermal processes to degrade, remove, or immobilize contaminants. More detailed discussions of these technologies follow.

Areas of Site -- This technology can potentially be applied to the problem areas of the site that include surface soils, subsurface soils, surface water, and und water. Areas associated with pecific technologies discussed in the paragraphs that follow.

Technical Considerations -- Key components associated with in situ technologies include methods for delivering treatment solutions to the subsurface and techniques for controlling the spread of contaminants and treatment agents beyond the treatment zone (i.e., ground water control). Therefore, extensive knowledge of site geology and hydrogeology is an important factor in the design of in situ treatment processes. In situ technologies may also generate by-products which require treatment/disposal.

In situ treatment technologies are generally much more sensitive to site-specific factors, including soil characteristics and site hydrogeology. Variations in site soil permeability for example, can have a profound effect on process design and effectiveness. Present information on site stratigraphy indicates relatively low permeabilities which may prohibit effective in situ treatments. Laboratory bench-scale and/or pilot-scale testing may be required to confirm the technical feasibility and/or determine the design and operating parameters for in situ treatment techniques implemented at the Southern Maryland Wood Treating site.

Other Considerations -- These are discussed below for individual technologies.

Recommendations -- Recommendations follow for individual in situ treatment technologies.

Biological

Description -- In situ biological treatment, also referred to as bioreclamation or biodegradation, is a technique for treating contaminated soils and ground water in place by microbial degradation. This is accomplished by the addition of oxygen and nutrients to soil and ground water to enhance the natural biodegradation of organic compounds by microorganisms, resulting in the breakdown and detoxification of the organic contaminants. These microorganisms can be either naturally-occurring, specially-adapted, or genetically-engineered.

Oxygen and nutrients are delivered to the soils through injection wells or an infiltration system. The ground water (sometimes accompanied by surfactants) is often used to carry the nutrients by recirculation through the treatment zone via ground water collection technologies.

Areas of Site -- This technology can potentially be applied to decontamination of surface soils, subsurface soils and ground water.

Technical Considerations -- Review of the literature indicates that bioreclamation has been used successfully in tests on materials contaminated with PNAs and acid extractable compounds. However, bioreclamation is sensitive to a number of environmental factors, including availability of trace nutrients, oxygen concentration, redox potential, pH, degree of water saturation, and temperature. These factors would have to be monitored and controlled during operation.

Laboratory/bench and/or pilot-scale tests would be required to confirm the feasibility of bioreclamation at the site and/or determine design and operating parameters. However, it is anticipated that there may be problems associated with in situ biological treatment because of the low soil permeabilities.

Other Considerations -- Contaminants could be mobilized into the ground water during treatment, possibly threatening the local environment. Ground water controls and possible surface controls could be required for this technology.

Recommendations -- In situ bioreclamation will be retained for further consideration.

Chemical

Soil Flushing

Description -- The in situ chemical treatment potentially applicable to the Southern Maryland Wood Treating site is soil flushing. This technology refers to methods that mobilize and extract contaminants from soils.

Soil flushing is accomplished by use of water or an aqueous chemical solution (i.e., water/surfactants or water/solvents) that is applied to the area of contamination, and then extracted for removal, recirculation, or on-site treatment and reinjection. This is usually accomplished by constructing infiltration galleries, injection wells, or other delivery methods and utilizing ground water extraction wells or trenches. The soil flushing system can be designed to function as an in situ bioreclamation system after flushing has removed contaminants in subsurface soils.

Areas of Site -- This technology can potentially be applied to the subsurface soils and surface soils, and can indirectly provide treatment to the ground water.

Technical Considerations -- Site-specific conditions such as soil type and chemistry dictate the operation and efficiency of this technology. The areas on-site with high proportions of sandy soils present favorable conditions for this technology. Solutions that have potential use at the Southern Maryland Wood Treating site include water/surfactant and/or alkaline agent, and water/organic solvent/surfactant solutions. These solutions would be best suited for removing the PNAs and other constituents of concern from the soils.

Drawbacks of these processes include the channeling of treatment solution through soils and the relatively low permeabilities of the site soils, and the hydraulic characteristics, as discussed previously. Due to these conditions, a large number of cycled pore volumes of treatment solution would be required for treatment. Recent technological advances have led to commercially available flushing methods that use different types of solutions (i.e., polymers) to form a "clam" which conveys contamination from adhered soils with a minimum of channeling, and can be used in combinations to "bypass" hydraulic problems. Such a scheme would reduce treatment time and expense and increase the effectiveness of the treatment scheme.

A disadvantage of this technology is that the elutriate stream (washing fluid) requires treatment and disposal. Therefore, treatment of large amounts of soil requires treatment of large volumes of washing fluid.

Laboratory- and/or pilot-scale testing would be required to confirm the feasibility, and/or determine the optimum flushing process design and operating parameters for the Southern Maryland Wood Treating site.

Other Considerations -- Potential risks associated with soil flushing systems include: contamination of soil and ground water from the washing fluids (use of additives that are biodegradable may prevent this potential contamination) and mobilization of contaminants into the surrounding environment (hydraulic barriers must be maintained). Also, some in situ soil flushing processes may be of proprietary status.

Recommendations -- Additional studies are required to adequately define the applicability of soil flushing at the Southern Maryland Wood Treating site. However, because it is a promising permanent treatment method, this technology will be retained for further consideration.

Physical

In Situ Absorption

Description -- In situ adsorption, or permeable treatment beds, consist of excavated trenches placed perpendicularly to ground water flow that are filled with material (i.e., activated carbon or ion exchange resins) to treat or adsorb the contaminants. This technology represents a passive scheme to remove and treat contamination.

Areas of Site -- This technology can potentially be applied to subsurface soil contamination which is evident at high concentrations of contaminants in the area southwest of the process area and northeast of the pond, and indirectly to ground water contamination.

Technical Considerations -- In situ adsorption is applicable to relatively shallow ground water aquifers. This technology is still in the developmental stages and has not been successfully applied to any sites as yet. However, laboratory and pilot testing has been performed which indicates that problems such as plugging and saturation of bed materials may occur. Studies point to the application of this technology as a temporary or short-term remedial action. Because a large amount of the contamination in the applicable area is in high concentrations in the soils, there may be problems with bed plugging or bed saturation fairly quickly.

Recommendations -- Because of technical considerations, this technology will not be retained for further consideration.

Supercritical Extraction

Description -- This technology involves an extraction method using fluids beyond their critical point, at a certain combination of temperature and pressure. The fluids experience greatly altered solvent properties that make extraction more rapid and efficient than conventional methods.

Areas of Site -- This technology can potentially be applied to the subsurface soils, surface soils, and indirectly to contaminated ground water.

Technical Considerations -- Supercritical extraction is in the early development stages (laboratory tests only) and sufficient information is not available to assess the applicability at the Southern Maryland Wood Treating site, especially considering the site hydraulic characteristics. Studies are presently being sponsored by EPA to determine applicability and limitations of this technology. There may be problems associated with this technology due to gaseous releases and heat input requirements.

Recommendations -- Because supercritical extraction is only in the early development stages at this time, this technology will not be retained for further consideration.

Thermal

In Situ Vitrification

Description -- The in situ thermal treatment potentially applicable to the Southern Maryland Wood Treating site is in situ vitrification. This technology utilizes radio-frequency electrodes that are placed in the ground surface. Organic contaminants are treated by vaporization or are pyrolyzed when electric current is passed through the electrodes. Inorganics and other remaining contaminants are immobilized as the soil is converted to a molten glass and turns into a stable glass and crystalline form upon cooling.

Areas of Site -- This technology can potentially be applied to surface soils and subsurface soils.

Technical Considerations -- This is a developing technology that has been extensively tested to treat soils contaminated with radioactive materials. Large-scale testing has been done (400 to 800 tons of vitrified mass), and has included treatment of soils contaminated with metals, PCBs, and organics associated with electroplating wastes. An electrical power source is required on-site to supply current for the electrodes. Pilot testing would be required to confirm the technical feasibility and/or determine the design and operating parameters of this technology.

<u>Other Considerations</u> -- The leachability of the contaminants that remain immobilized in the vitrified mass is expected to be negligible. Also, in consideration of local environmental impacts, off-gases generated during the process are captured in a hood. Operating costs associated with this technology are relatively high because of the high power requirements. Capital costs are also high because the electrodes are left in the ground and become part of the crystalline mass.

<u>Recommendations</u> -- In situ vitrification is a promising permanent treatment method and will be retained for further consideration.

<u>On-Site Treatment</u>

<u>Description</u> -- On-site treatment technologies refer to processes that can treat the contaminated soils and ground/surface water on-site, normally with mobile treatment units, and can include biological, chemical, thermal, and physical processes. These technologies that are implemented at the site, often involve excavation or removal of the materials to be treated, and rely on the use of biological or chemical agents and/or physical or thermal processes to degrade, remove, destroy, or immobilize contaminants. More detailed discussions of these technologies follow.

<u>Areas of Site</u> -- This technology can potentially be applied to all of the problem areas of the site, including surface soils, subsurface soils, sediments, ground water, surface water, and

storage/process tank materials, including those areas contaminated with dioxins. On-site treatment is also applicable to the washing extracts and sediment dredging water that are by-products of other technologies. Areas associated with specific technologies are discussed in the paragraphs that follow.

Technical Considerations -- Discussions on technical considerations follow for individual technologies. Some on-site treatment technologies are not as developed as other currently available technologies for site remediation. Laboratory bench-scale and/or pilot-scale testing may be required to confirm the feasibility and/or determine the operating and design parameters for certain on-site treatment techniques implemented at the Southern Maryland Wood Treating site.

Other Considerations -- Under SARA, permitting requirements for on-site treatment processes are less restrictive than under CERCLA. However, the treatment schemes must meet with approval of local and state agencies. Other considerations are also discussed for individual on-site treatment techniques, where applicable.

Recommendations -- Recommendations are listed below for individual on-site treatment technologies.

Thermal

Incineration

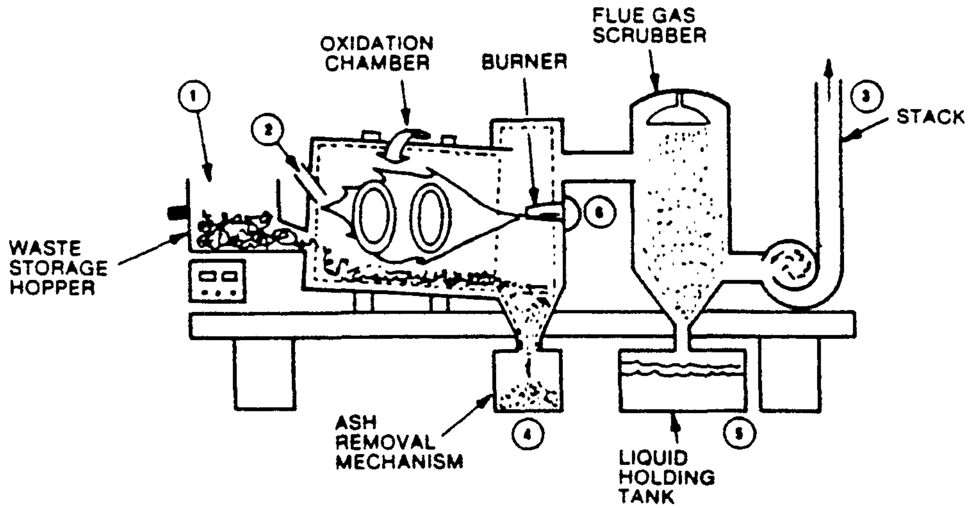
Description -- With treatment by incineration, materials contaminated with organics are destroyed by controlled combustion under net oxidizing conditions. The products of incineration generally include CO_2, H_2O vapor, SO_2, NOx, HCl gases, and ash. Incineration can be used to destroy organic contaminants in liquid, gaseous, and solid wastes.

Methods potentially applicable to the Southern Maryland Wood Treating site include rotary kiln and fluidized bed incineration, as well as a more recent innovative infrared technique. Rotary kiln incinerators utilize a rotary kiln as the primary furnace configuration for combustion, as shown in Figure 6-3. Fluidized bed incinerators (and circulating bed combustors) are refractory-lined vessels containing a bed of inert granular material (i.e., silica sand) that is heated by combustion air. The waste materials are burned when they contact the hot bed material. Infrared incinerators subject waste materials to intense infrared radiation, which causes combustion of waste with a minimum of particulate-producing turbulence.

Areas of Site -- This technology can potentially be applied to surface soils, subsurface soils, sediments, tank wastes, and dioxins. Incineration of some soils may require excessive time and expense due to the large volume and low BTU content material to be treated. Treatment of all soils by incineration may not be practicable, depending on the volumes and concentrations of organics (which affects the BTU value) in the soil.

Technical Considerations -- Most incineration technologies are well-developed and proven. Rotary kiln incinerators are commercially available and in wide use. Fluidized bed incinerators are commercially available but are not presently used for hazardous waste treatment commercially. Infrared systems are relatively new, and mobile units may not be available at the time of remediation. Gaseous and aqueous emissions require pollution control devices and the ash product requires proper disposal.

Incinerators are capable of accepting all matrices of organic wastes. However, oversize pieces of material have to be reduced before being fed into the fluidized bed and infrared incinerators. Pilot-scale tests (i.e., a trial burn) may be



Legend

1. Influent Waste
2. Combustion Air
3. Flue Gas
4. Residuals
5. Scrubber Water
6. Fuel

Source: Ghassami, Yu, and Quinlivan, 1981

FIGURE 6-3 ROTARY KILN INCINERATOR SCHEMATIC required to determine the design and operating parameters for application of some incineration technologies at the Southern Maryland Wood Treating site.

Other Considerations -- Incineration is a desirable technology because the contaminants are permanently destroyed. However, the local environment needs to be protected from the gaseous emissions, which can be accomplished with conventional pollution control devices. Under SARA, permitting requirements are less restrictive. For on-site incineration, agency approval would be required for design and operating parameters. There are high costs associated with incineration of soils due to the low BTU content (heating value) of the materials.

Recommendations -- Incineration will be retained for further consideration because it is a promising permanent treatment technology.

Pyrolysis

Description -- Pyrolysis technologies potentially applicable to this site are the plasma arc and the advanced electric reactor (AER) processes. In pyrolysis, thermal decomposition occurs when wastes are heated in an oxygen deficient atmosphere. Gases are the principal product generated by the process, although ash or "char" can also be generated.

The plasma arc technology utilizes a colinear electrode to generate a plasma or electric arc that creates extremely high temperatures (approaching 10,000°C) to atomize the wastes. The AER, also known as a high temperature fluid wall (HTFW) uses radiation for energy transfer. Waste materials are broken down to carbon, carbon monoxide, and hydrogen by thermolysis at high temperatures in a carbon core reactor vessel.

Areas of Site -- This technology can potentially be applied to surface soils, the subsurface soils, sediments, tank wastes (including dioxins), ground water, surface water, washing extracts, and sediment dredging water.

Technical Considerations -- Plasma arc processes have been demonstrated at pilot-plant scale; however the process is presently limited to liquids and continuous operation has not been demonstrated. The AER or HTFW reactor was originally developed to treat contaminated soils and is commercially available in pilot-scale mobile systems. However, waste solids must be reduced to the size of fine sand ($\leq$35 mesh), liquids must be atomized to very small droplet size ($\leq$1500 microns), and sludges cannot be handled by the process. The applicability of this technology may be a problem because much of the contaminated material to be treated at the Southern Maryland Wood Treating site will be soils having a consistency similar to sludge due to high water content.

This technology may be applicable for treatment of ground water and surface water (depending on the solids content). However, it may be more advantageous to select a treatment method applicable to several matricies of contaminated materials. Laboratory bench-scale and/or pilot-scale testing would be required to confirm the feasibility of and determine the operating and design parameters for pyrolysis as implemented for ground water or surface water treatment at the Southern Maryland Wood Treating site.

Recommendations -- Because of potential materials handling problems, and/or size reduction requirements associated with pyrolysis processes, this technology will be retained for further consideration only for ground water and surface water treatment.

Wet Air Oxidation

Description -- With wet air oxidation, organic materials are broken down by oxidation in a high temperature and pressure aqueous environment in the presence of compressed air. Steam is a potential by-product of this process.

Areas of Site -- This technology can potentially be applied to ground water, tank wastes, surface water, sediment dredging water, and washing extracts.

Technical Considerations -- Wet air oxidation has been demonstrated extensively for industrial applications, however utilization is limited for treatment of hazardous waste. There are existing full-scale, fixed facilities. Use of this process is limited to pumpable aqueous wastes and a particular COD concentration range.

Laboratory bench-scale and/or pilot-scale testing would be required to confirm the feasibility and determine the design and operating parameter for wet air oxidation treatment of the contaminated materials at the site. It may be more advantageous to select a treatment method applicable to several matricies of contaminated materials.

Recommendations Until more detailed information is available concerning volumes and types of wastes to be treated, wet air oxidation will be retained for further consideration.

Chemical/Physical

Description -- On-site chemical and physical treatment technologies potentially applicable at the Southern Maryland Wood Treating site include soil washing/extraction and macroencapsulation/overpacking. These technologies are screened individually in the paragraphs that follow.

Soil Washing/Extraction

Description -- Soil washing or extraction techniques are similar to in situ soil flushing techniques as described previously with the exception that the contaminated soils and other materials are excavated and/or dredged and are treated on-site. This technology refers to methods for removing contaminants by use of a water or aqueous chemical solution (i.e., water/ surfactants or water/solvents), which is applied to the contaminated material after it has been removed from the source area. Treatment is usually performed using a multistaged batch process.

Areas of Site -- This technology can potentially be applied to surface soils, the subsurface soils, sediments and tank wastes.

Technical Considerations -- Solutions that have potential use at the Southern Maryland Wood Treating site include water/surfactant and/or alkaline agents, and water/organic solvent/surfactant solutions. These solutions would be best suited for removing the PNAs and other constituents of concern from the contaminated materials. Work has been performed in this area using a froth flotation process with these solutions, utilizing off-the-shelf equipment from the mining industry.

A disadvantage of this technology is that the elutriate stream requires treatment and disposal. Therefore, this technology is probably not feasible for use on all of the soils deemed for remediation because of the potentially large volume of soils to be treated, which will result in large volumes of washing fluid.

Laboratory- and/or pilot-scale testing would be required to confirm the feasibility and/or to determine the optimal the on-site soil washing process design for the Southern Maryland Wood Treating site.

Other Considerations -- There would be high costs associated with excavation if this technology were to be applied to all problem areas of the site. However, it would be most attractive to apply on-site soil washing to "hot spots" or materials with high concentrations of constituents. Some washing schemes may be of proprietary status.

Recommendations -- Because it is a promising permanent treatment technology, on-site soil washing/extraction will be retained for further consideration.

Macroecapsulation/Overpacking

Description -- Macroencapsulation is a technique for containing waste materials by encapsulating large particles in an environmentally secure barrier. Materials such as lime or cement pozzolan, thermoplastics, or organic polymers are used to contain the waste in a nodule form which can be assimilated by placing the contaminated materials in small "barrels."

Areas of Site -- This technology can potentially be applied to surface soils, subsurface soils, tank wastes and sediments.

Technical Considerations -- Macroencapsulation is attractive because the resulting nodules are isolated and exhibit low permeability and good bearing strength. However, product placement is very important and may require a secure landfill. Leaching can result from the presence of free liquid (i.e., wet soils/sediments or precipitation) and the resultant product. Also, laboratory and/or pilot-scale tests would be required to find an optimum macroencapsulation material that would be compatible with the site waste materials.

Other Considerations: The risks associated with this technology include the possibility of leaching the contaminated materials from the nodules. This would pose a threat to the local environment, especially since the waste materials form a matrix at the "node walls," and are not uniformly dispersed in the encapsulating material.

Recommendations -- Macroencapsulation will not be retained for further consideration due to environmental and technical reliability uncertainties.

Chemical Oxidation/Reduction

Description -- In chemical oxidation and reduction reactions, chemical transformation of reactants occurs and the contaminants are destroyed or the toxicity is reduced by raising the oxidation state of one reactant while lowering that of another. Oxidizing agents potentially applicable to the Southern Maryland Wood Treating site include ozone, ultraviolet (UV) photolysis, and a combination of UV and ozone.

Areas of Site -- This technology can potentially be applied to ground water, tank wastes, surface water, sediment dredging water, washing extracts, and dioxins.

Technical Considerations -- Chemical oxidation/reduction is currently limited to treatment of liquid streams and the effectiveness of the process drops significantly with high concentrations of constituents. For example, UV light cannot effectively penetrate soil or opaque materials and ozone is effective for streams with less than 1.0 percent oxidizable compounds.

UV photolysis has been demonstrated to be effective for treatment of dioxins, however the dioxins must be extracted in a clear liquid prior to treatment.

Laboratory bench-scale and/or pilot-scale testing would be required to confirm the feasibility and to determine the operating and design parameters for implementation of chemical oxidation/reduction at the site. This process may be best effective as a polishing step for other treatment methods. However, it may be more advantageous to select a treatment method applicable to several matricies of contaminated materials.

Other Considerations -- Cost may escalate rapidly for wastes with high organic concentrations (>100 ppm) due to requirements for large volumes of oxidizing agents.

Recommendations -- Until more detailed information is available concerning volumes and types of wastes to be treated, chemical oxidation/reduction will be retained for further consideration.

Activated Carbon Adsorption

Description -- Activated carbon adsorption is a common procedure used for removing trace organics from aqueous streams. In this process, the constituents are "adsorbed" or bonded to the carbon as the stream flows through the treatment bed.

Areas of Site -- This technology can potentially be applied to ground water, surface water, sediment dredging water, and washing extracts.

Technical Considerations -- There are limitations of the carbon adsorption process which restrict treatment of waste streams that contain greater than 50 ppm suspended solids and 10,000 ppm organic concentrations. Pretreatment methods such as mixed-media (i.e., sand) filtration can be used to remove solids. However, the presence of elevated concentrations of constituents (i.e., highly contaminated material in ground water) may restrict utilization of this technology at the site. Based on present information, it is expected that there may be problems with application of this technology due to clogging of the carbon beds and/or generation of large amounts of spent carbon.

Pre-treatment studies may be required to determine the design and operating parameters for carbon adsorption. This process may be most effective as a polishing step for other treatment methods. However, it may be more advantageous to select a treatment method applicable to several matricies of contaminated materials.

Other Considerations -- Exhausted carbon which contains the concentrated contaminants must be disposed of or treated/ regenerated.

Recommendations -- Until more detailed information is available concerning volumes and types of wastes to be treated, carbon adsorption will be retained for further consideration.

Ion Exchange

Description -- Ion exchange is similar to activated carbon adsorption, however in this process, the mechanism is an exchange of the ion electrostatically attached to a solid resin material and a dissolved organic ion.

Areas of Site -- This technology can potentially be applied to ground water, surface water, sediment dredging water, and washing extracts.

Technical Considerations -- There are limitations of the ion exchange process which restrict treatment of waste streams that contain greater than 50 ppm suspended solids and 2,500 ppm organic concentrations (similar to carbon adsorption but significantly lower upper organic concentration limit). Pretreatment methods such as mixed-media (i.e., sand) filtration can be used to remove solids. However, the presence of elevated concentrations of constituents (i.e., high concentrations of contaminants in ground water) may restrict utilization of this technology at the site. Based on present information, it is expected that there may be problems with application of this technology due to clogging of the resin beds and/or regeneration of large amounts of resin material. In practice, this technology has been applied mostly to metals/inorganics.

Pilot-scale treatability studies would be required to confirm the feasibility and to determine the design and operating parameters for ion exchange. This process may be best effective as a polishing step for other treatment methods. However, it may be more advantageous to select a treatment method applicable to several matricies of contaminated materials.

Other Considerations -- High concentrations of organics to be treated may result in rapid exhaustion of resin material and associated high regeneration costs.

Recommendations -- Because of technical considerations, ion exchange will not be retained for further consideration.

Membrane Separation

Description -- Membrane separation technologies utilize semi-permeable membranes to separate contaminants from liquids, by rejecting contaminants because of the pore size, ion valence or co-precipitation. The most common and most developed technique for on-site use is reverse osmosis which uses a pressure driven membrane process.

Areas of Site -- This technology can potentially be applied to ground water, surface water, sediment dredging water, and washing extracts.

Technical Considerations -- There are limitations of the membrane exchange process which restrict treatment of waste streams to those that contain organic constituents in aqueous streams in concentrations in milligrams per liter. Clogging of the membrane can occur from excessive levels of suspended solids. Also, the presence of elevated concentrations of constituents may prohibit utilization of this technology at the site.

Laboratory and/or pilot-scale treatability studies would be required to confirm the feasibility of and to determine the design and operating parameters for membrane separation, and to determine the compatibility of the membrane material with the contaminants. This process is most effective as a polishing step for other treatment methods.

Other Considerations -- Concentrations of solutes in the effluent stream remain in the 10 to 100 ug/l range which may be above acceptable levels, and the concentrated solution must be treated and/or disposed of following treatment of the waste stream.

Recommendations -- Based on technical considerations, membrane separation processes will not be retained for further consideration.

Biological

Description -- On-site biological treatment technologies potentially applicable to this site are land treatment/ composting, aerobic treatment and anaerobic treatment. Each of these technologies are discussed in detail below.

Land Farming/Composting

Description -- Land farming methods are directed towards enhancing biochemical mechanisms to detoxify or decompose the contaminants in the soil. This is accomplished by oxygenating the soil and adding nutrients to the soil using agricultural-type equipment (i.e., tillers and plows) and an irrigation and drainage system. Native or specialized microorganisms can be utilized. The mechanism for composting is similar to land farming, however, the soil materials are mixed in at a small percentage ($\leq$10 percent) with a biodegradable and structurally-firm material such as chopped hay or livestock feed.

For application at the Southern Maryland Wood Treating site, contaminated soils and sediments to be treated would be excavated and placed in a designated area on-site for treatment.

Areas of Site -- This technology can potentially be applied to surface soils, subsurface soils, tank wastes, and sediments.

Technical Considerations -- Biological land treatment and composting techniques have been used successfully for treatment of aromatic hydrocarbons. However, the sensitivity of biological treatment warrants careful control of environmental conditions.

High levels of some organics could be toxic to the micro-organisms. Therefore, laboratory- and/or pilot-scale tests would be required to confirm the feasibility of of this technology and determine the optimum land farming/composting technique for the problem areas of the site. It is anticipated that land farming/composting would be most applicable to surface soils. It is possible that higher level materials could be blended into lower contaminant level soils to prevent injury to the microorganisms.

Other Considerations -- Contaminants could be mobilized into the ground water during treatment, possibly threatening the local environment. Strict operating conditions would likely be required in the treatment areas to ensure minimum vertical migration of contaminants, and control of surface water and sediment runoff from the treatment area.

Recommendations -- Additional investigation is required to confirm the feasibility of this technology. However, because it is a promising permanent treatment method, it will be retained for further consideration.

Aerobic Treatment

Description -- Aerobic biological treatment methods use microorganisms to detoxify or decompose biodegradable organics in aqueous waste streams. This technology utilizes conventional activated sludge processes and modifications of these which include fixed film reactors, sequential batch reactors, trickling filters, and rotating biological contactors.

Areas of Site -- This technology can potentially be applied to ground water, surface water, sediment dredging water, and washing extracts.

Technical Considerations -- Aerobic biological treatment techniques have been used successfully for treatment of phenols, PCP, and fuel oil in low level concentrations. Other hydrocarbons may are treatable with addition of catalysts such as activated carbon. However, the sensitivity of biological treatment warrants careful control of operating conditions.

Application of this technology is limited to low levels (<10,000 ppm) of halogenated organics in an aqueous waste stream. Therefore, the presence of elevated concentrations of constituents may prohibit effective use of aerobic treatment at the site. Laboratory- and/or pilot-scale tests would be required to confirm the feasibility of this technology and to determine the optimum process for the site.

Other Considerations: Process by-products including settled sludge and/or spent carbon will require treatment and/or disposal. Monitoring and/or control measures may be required due to the emission of volatile organics during the aeration steps of the process.

Recommendations -- Additional information concerning the volumes and characteristics of the waste streams to be generated from remediation of the Southern Maryland Wood Treating site is required to assess the applicability of this technology. However, because it is a promising permanent treatment method, it will be retained for further consideration.

Anaerobic Treatment

Description -- In anaerobic biological treatment systems, organic matter is reduced to methane and carbon dioxide in an oxygen-free environment. A more common process utilizes a column filled with solid media as an anaerobic filter. This process is capable of handling high strength aqueous wastes that are not efficiently treated by aerobic treatment processes.

Areas of Site -- This technology can potentially be applied to ground water, surface water, sediment dredging water, and washing extracts.

Technical Considerations -- Anaerobic biological treatment processes can handle more concentrated waste streams than aerobic treatment, but are very sensitive and are more susceptible to changes in stream characteristics, which can cause shock loading and termination of the biological process. For this reason anaerobic treatment has not been applied to CERCLA waste streams on a frequent basis. Laboratory- and/or pilot-scale tests would be required to confirm the feasibility of this technology and to determine the optimum process for the site.

Other Considerations -- A by-product of the process is methane gas, for which monitoring is required to protect the local environment. The methane can potentially be recovered for use to meet energy requirements on-site.

Recommendations -- Additional information concerning the waste streams is required to assess the applicability of anaerobic biological treatment methods. However, because it is a promising permanent treatment method, anaerobic treatment will be retained along with aerobic treatment for further consideration.

Solidification/Stabilization

Description -- Solidification or stabilization, also referred to as immobilization, is a process that combines the soil materials physically and/or chemically with binding materials to decrease the mobility of the constituents. Application at the Southern Maryland Wood Treating site would involve excavation of the contaminated soils and sediments and conversion of these soils to a solid mass that would "fully" immobilize the leachable contaminants, followed by disposal on-site.

Various binding materials are available, including cement and pozzolanic materials (e.g., fly ash), which are widely used. Other binding agents include organic polymers or combinations of cement/pozzolan and polymers. Also, the waste materials can be microencapsulated in thermoplastic materials such as asphalt.

Areas of Site -- This technology can potentially be applied to surface soils, the subsurface soils, tank wastes, and sediments.

Technical Considerations -- Solidification/stabilization has been used successfully to immobilize waste materials. However, certain binding materials are sensitive to wastes containing organics. Laboratory bench-scale and/or pilot-scale tests would be required to confirm the feasibility of the technology (i.e., show that the soil contaminants are "fully" immobilized) and to determine the optimal binding material for the Southern Maryland Wood Treating site materials. Information available on this technology indicates that it is possible to get a solid bound product that would pass the RCRA leaching tests. These treated soils could potentially be "de-listed" and disposed of on-site. Bench-scale testing on both heavily contaminated soils similar to those present at the Southern Maryland Wood Treating site indicate that such materials can be solidified successfully. To this date, leaching tests have not been performed on these samples.

Other Considerations -- Some solidification/stabilization technologies experience a volume reduction, however, with other technologies and certain matricies, the immobilized waste volume may increase, even double. Therefore, on-site space limitations may limit implementation.

Recommendations -- Solidification/stabilization will be retained for further consideration.

Off-Site Treatment

There are other off-site treatment technologies available at permitted commercial treatment, storage, and disposal (TSD) facilities that may be applicable to the Southern Maryland Wood Treating site. However, the majority of these technologies (i.e., solidification/stabilization) are for the most part used as pretreatment steps by TSDs prior to placing materials in a landfill. Therefore, these technologies are not considered separately and are assumed to be included, if necessary, with off-site disposal.

Also, some technologies that were discussed as on-site treatment technologies are commercially available as off-site treatment methods. These technologies include biological (aerobic treatment and anaerobic treatment), and chemical/physical (soil washing/extraction and chemical oxidation/reduction) treatment methods. These technologies are not discussed separately under this section and the discussions for on-site treatment are assumed to apply for off-site treatment.

Thermal: Incineration

Description -- An off-site thermal treatment technology potentially applicable to the Southern Maryland Wood Treating site is incineration.

The off-site incineration option addresses destruction of materials contaminated with organics by excavation and/or dredging, and then transport to an off-site commercial facility. Such incineration facilities that have rotary and cement kiln systems in operation are capable of accepting sludges and soils for treatment.

Areas of Site -- This technology can potentially be applied to surface soils, subsurface soils, tank wastes (including dioxins) and sediments.

Technical Considerations: Because they are commercially available, off-site incinerators represent a well-developed and proven technology. Incinerators are capable of accepting all matrices of organic wastes. However, commercial incinerator capacity is limited and a sample of the waste material must be accepted by the TSD facility before the material can be treated. Presently, commercial facilities are not set up to handle bulk loads of waste materials.

Incineration of some soils may require excessive time and expense due to the large volume and low BTU content of material to be treated. Treatment of soils by incineration may be selective and based on total contaminant concentration/BTU content.

Other Considerations -- There are no local environmental impacts because the waste materials are removed from the site and are permanently destroyed. Using off-site facilities requires that U.S. DOT requirements for hazardous waste transport are met. There may be problems associated with transport and/or acceptance of wastes containing dioxins. There are high costs associated with incineration of soils due to the low BTU content of the materials.

Recommendations -- Incineration will be retained for further consideration because it is a permanent treatment technology.

Off-Site Disposal

Description -- Off-site disposal involves excavation of the contaminated materials and transportation of the materials to an approved disposal site that meets applicable RCRA requirements and regulations.

Areas of Site -- This technology can potentially be applied to surface soils, the gross subsurface contamination, tank wastes, sediments, and demolished buildings/tanks/process equipment.

Technical Considerations -- This technology is feasible because all aspects of off-site disposal are based on standard engineering practices. RCRA requires a hazardous waste landfill to have a lined base and sides, a leachate and runoff collection system, and a final cover to reduce infiltration.

Other Considerations -- Commercial disposal facilities must meet stringent analytical, state permitting and compliance standards. Using off-site facilities requires meeting U.S. DOT requirements for hazardous waste transport. Commercial RCRA landfill capacity is limited; therefore, the type and quantities of waste must be approved by the facility before disposal. The off-site facilities may be reluctant to accept large quantities of waste. In addition, sediments and tank wastes will likely require dewatering and/or solidification/stabilization prior to landfilling.

EPA is currently developing treatment standards, technologies, and implementation schedules in conjunction with a November 8, 1988 ban on land disposal of soil and debris. These standards and technologies are expected to be published prior to the completion of the final feasibility study and will be considered in future evaluations of alternatives.

There are no local environmental impacts associated with off-site disposal, providing erosion and sediment control measures are followed during excavation activities, because the waste materials are removed from the site to a more secure location. This technology does not however treat the contamination.

Recommendations -- Off-site disposal will be retained for further consideration.

On-Site Disposal

Description -- On-site disposal of contaminated materials at the Southern Maryland Wood Treating site would include the construction of a secure landfill or above-ground vault on-site, incorporating a double-liner system. The landfill or vault would require compliance with RCRA standards for both liner and cover systems. The contaminated materials would be partially or completely excavated and placed in the on-site landfill.

Areas of Site -- This technology can potentially be applied to surface soils, the subsurface soils, tank wastes (including dioxins) sediments, and demolished buildings/tanks/process equipment.

Technical Considerations -- This technology appears to be feasible because it is well developed and proven; secure landfills exist commercially. The use of above-ground vaults is relatively new and not widespread, and may be required for use on this site because of the relatively high water table. The landfill would have to be constructed essentially above-grade. The extensive quantity of surface soils would require an extremely large vault, however presently on-site there exists a large amount of open area or areas that could be cleared for placement of a landfill or vault.

In addition to the RCRA design standards, post-closure care, maintenance, and leachate management would be required. Some contaminated materials may require solidification/stabilization prior to on-site disposal.

Other Considerations -- The cost of this technology would be very high and would include design, construction, and operation of the landfill or vault. According to SARA, on-site remedial technologies do not require permits. This may make the time-frame shorter than what is to be expected from a permitting process; however, the landfill or vault must meet with the approval of state and local agencies which may include most of all of permit requirements. There may be problems with obtaining approval for on-site disposal of dioxins. This technology does not require transportation of waste material off-site and may provide secure containment on-site but does not treat the contaminated materials.

Recommendations -- On-site disposal will be retained for further consideration.

6.5 ORDER-OF-MAGNITUDE COST SCREENING

Under SARA, technologies cannot be eliminated based on cost considerations. However, order-of-magnitude costs will be developed to screen from further consideration those technologies for which costs of implementation are significantly higher, but which do not produce a greater benefit in terms of addressing remedial action objectives or in terms of ease and reliability in implementation. Consideration will be taken for alternative and/or innovative technologies. Only those technologies that have passed the screening process detailed in Subsection 6.4, as updated following Phase III of the RI, are included. Table 6-2 presents relative order-of-magnitude costs for retained technologies in terms of "low," "moderate," "high" and "extremely high." These ratings are based on current information from literature and EPA documents concerning these technologies, and knowledge of similar remedial action applications. An attempt is made to consider in these ratings the cost of contingency measures or problems associated with implementation of the technologies (i.e., excavation below the water table, etc.).

Order-of-magnitude costs will be developed when more information concerning volumes and types of wastes will be available from Phase III of the RI.

6.6 SUMMARY OF TECHNOLOGIES

The screening of the remedial technologies is summarized in Table 6-3. The technologies that have been retained after the screening process for use in developing remedial action alternatives are listed as follows:

TABLE 6-2

RELATIVE ORDER-OF-MAGNITUDE COSTS FOR REMEDIAL TECHNOLOGIES APPLICABLE TO THE SOUTHERN MARYLAND WOOD TREATING SITE

RETAINED TECHNOLOGY	RELATIVE COST
1. No Action:	
No action with security upgrade and monitoring.	LOW
2. Diversion and Collection:	
Regrading, revegetation, and diversion.	LOW
Sedimentation ponds and basins.	LOW
3. Capping and Ground Water Containment/Controls:	
Synthetic membrane cap.	MODERATE
Low permeability soils cap.	MODERATE
Asphalt cap.	MODERATE
Multilayer cover system.	MODERATE
Ground water containment techniques.	MODERATE

NOTE: Costs of some technologies are highly dependent upon the laboratory/pilot-scale testing required for the development of the process and the amount of material to be treated at the Southern Maryland Wood Treating site.

TABLE 6-2 (continued)

RELATIVE ORDER-OF-MAGNITUDE COSTS FOR REMEDIAL TECHNOLOGIES
APPLICABLE TO THE SOUTHERN MARYLAND WOOD TREATING SITE

RETAINED TECHNOLOGY	RELATIVE COST
3. Capping and Ground Water Containment/Controls (continued):	
Ground water pumping.	MODERATE
Interception trenches, ditches, drains.	LOW/MODERATE
4. Complete Removal:	
Excavation/dredging and building/tank removal.	MODERATE
5. In Situ Treatment:	
Biodegradation/ bioreclamation.	MODERATE/HIGH
Chemical: Soil flushing.	MODERATE/HIGH
Thermal: In situ vitrification.	EXTREMELY HIGH
6. On-Site Treatment:	
Thermal: Incineration.	HIGH

NOTE: Costs of some technologies are highly dependent upon the laboratory/pilot-scale testing required for the development of the process and the amount of material to be treated at the Southern Maryland Wood Treating

TABLE 6-2 (continued)

RELATIVE ORDER-OF-MAGNITUDE COSTS FOR REMEDIAL TECHNOLOGIES APPLICABLE TO THE SOUTHERN MARYLAND WOOD TREATING SITE

RETAINED TECHNOLOGY	RELATIVE COST
6. On-Site Treatment (continued):	
Thermal: Pyrolysis -- o Plasma arc. o AER/HTFW reactor.	MODERATE/HIGH
Thermal: Wet air oxidation.	MODERATE/HIGH
Chemical/Physical: Soil washing/ extraction.	MODERATE/HIGH
Chemical: Oxidation/ reduction.	MODERATE/HIGH
Physical: Activated carbon adsorption.	MODERATE/HIGH
Biological: Land farming/composting.	MODERATE
Biological: Aerobic treatment.	MODERATE/HIGH
Biological: Anaerobic treatment.	MODERATE/HIGH
Solidification/ stabilization.	MODERATE/HIGH

NOTE: Costs of some technologies are highly dependent upon the laboratory/pilot-scale testing required for the development of the process and the amount of material to be treated at the Southern Maryland Wood Treating site.

TABLE 6-2 (continued)

RELATIVE ORDER-OF-MAGNITUDE COSTS FOR REMEDIAL TECHNOLOGIES APPLICABLE TO THE SOUTHERN MARYLAND WOOD TREATING SITE

RETAINED TECHNOLOGY	RELATIVE COST
7. Off-Site Treatment:	
Thermal: Incineration	HIGH/EXTREMELY HIGH
8. Off-Site Disposal	HIGH/EXTREMELY HIGH
9. On-Site Disposal	MODERATE/HIGH

NOTE: Costs of some technologies are highly dependent upon the laboratory/pilot-scale testing required for the development of the process and the amount of material to be treated at the Southern Maryland Wood Treating site.

TABLE 6-3

SUMMARY OF TECHNOLOGY SCREENING FOR THE SOUTHERN MARYLAND WOOD TREATING SITE

General Response Action And Associated Remedial Technologies	Retained for Alternative Development	Technical Considerations	Other Considerations	Recommended Application to Site Problem in Remedial Alternative
1. No Action				
a. No Action	No	Contaminant migration from on-site soils/sediments continues via existing drainage pathways and the pond towards off-site areas. MacIntosh Run, and/or residential wells.	Does not remediate potential public threat or environmental threats. Cannot determine on- or off-site contaminant concentrations. Unacceptable to regulatory agencies.	N/A
b. No action with security upgrade and monitoring.	Yes	Contaminant migration continues off-site and may impact Macintosh Run, tributaries, and/or residential wells; however, concentrations will be monitored.	Contaminant migration not restricted, but site access is limited and "early warning" is provided by monitoring when drinking water supplies may be threatened. May not be acceptable to public or regulatory agencies.	Surface soils Sediments Subsurface soils Surface water Ground water Buildings/tanks Tank wastes Dioxins
2. Diversion and Collection				
a. Regrading, revegetation, and diversion	Yes	Ditches, swales, berms, regrading, and revegetation would divert run-on and enhance surface run-off, therefore, reducing generation of leachate induced by infiltration.	Public health and environmental impacts reduced by restricting contaminant migration due to surface infiltration/run-off. Does not restrict migration due to ground water infiltration through subsurface contamination. May be acceptable to regulatory agencies when used in conjuction with other technologies.	Surface soils Sediments Surface water Ground water
b. Sedimentation ponds and basins	Yes	Utilizes standard construction techniques. Ponds and basins would allow for collection of potential upgradient site run-off and control of contaminated sediment transport.	Sedimentation ponds provide the opportunity to regulate/monitor discharge of run-off. Acceptable to regulatory agencies if used in conjunction with other technologies.	Surface soils Sediments Surface water Ground water

TABLE 6-3

SUMMARY OF TECHNOLOGY SCREENING FOR THE SOUTHERN MARYLAND WOOD TREATING SITE

General Response Action And Associated Remedial Technologies	Retained for Alternative Development	Technical Considerations	Other Considerations	Recommended Application to Site Problem in Remedial Alternative
3. Capping and groundwater containment/controls				
a. Synthetic membrane cap	Yes	Low permeability and applicability on sloping terrains. Potential for failure from physical damage. Site retail operation/buildings may interfere with cap effectiveness. Proper seaming is important for integrity.	Reduces surface infiltration and therefore reduces environmental impacts due to limiting leachate generation/contaminant migration. Does not restrict infiltration of ground water through subsurface contamination; must meet RCRA design standards for surface capping.	Surface soils Sediments Subsurface soils
b. Low permeability soils cap	Yes	Natural materials are "self-healing" to some extent if environment causes physical damage to the cap. Adequate supplies of native low permeabilities may be available locally. Site operations/buildings may interfere with cap effectiveness.	Same as 3 a.	Surface soils Sediments Subsurface soils
c. Soil admixtures cap	No	Incorporates a combination of natural and other materials such as processed bentonite; other equally effective, less costly materials available. Site operations/buildings may interefere with cap effectiveness.	Same as 3 a.	N/A
d. Asphalt or concrete cap	Yes (asphalt)	Long-term effects of environment and weathering could result in physical damage to the asphalt/concrete and reduce the effectiveness of the cap; site operations/buildings may interfere with cap effectiveness.	Same as 3 a.	Surface soils Sediments Subsurface soils Site traffic/storage
e. Multilayer cover system	Yes	Can reduce up to 90 percent of infiltration of precipitation. Long-term effectiveness due to construction of natural materials: drain layer diverts precipitation away from cap. Site operations/buildings may interfere with cap effectiveness	Same 3 a.	Surface soils Sediments Subsurface soils

TABLE 6-3

SUMMARY OF TECHNOLOGY SCREENING FOR THE SOUTHERN MARYLAND WOOD TREATING SITE

General Response Action And Associated Remedial Technologies	Retained for Alternative Development	Technical Considerations	Other Considerations	Recommended Application to Site Problem in Remedial Alternative
f. Ground water containment techniques • slurry wall • grout curtain • sheet piling • bottom sealing • directional grouting	Yes	Can be implemented using conventional and/or developed techniques. Subsurface wall or curtain could be tied into clayey silt layer ~20 to 30 below surface. May be problems with installation due to high water table and loose/medium nature of soil.	Restricts groundwater flow and therefore reduces environmental impacts due to limiting contaminant migration via groundwater.	Ground water
g. Interception trenches, ditches, drains	Yes	Utilizes common constuction practices, i.e., trenches, subsurface drains. May be trench construction problems due to high water table and loose nature of soils. May have to be used in with groundwater containment.	Same as 3 f.	Ground water
h. Groundwater pumping	Yes	Utilizes common well installation methods. Low hyraulic conductivities and limited saturated thickness of shallow aquifer restrict radial influence of individual wells. Large number of wells required.	Same as 3 f.	Ground water
4. Complete or Partial Removal				
a. Excavation/dredging and building/tank removal	Yes	Utilizes common construction techniques to physically remove contaminated soils/residues by excavation and/or dredging which are sent off-site for disposal/treatment. Contaminated water associated with sediment removal needs to be treated Site operations/buildings may interfere with complete removal of contaminated materials. Problems may be encountered with excavation below water table.	Reduces threats to public health and environment by removing sources of contamination; excavation activities may cause odor/dust problems and also require state-mandated sediment/erosion control procedures acceptable to regulatory agencies.	Surface soils Sediments Subsurface soils Buildings/tanks Tank wastes
5. In Situ Treatment				
a. Biological: biodegradation/bioreclamation	Yes	Developing technology showing success in treatment of PNAs. High levels of organics may be toxic to microorganisms. Bench and/or pilot studies would be required before implementation. Low soil permeabilities indicate that in-situ biological treatment may be difficult to implement at this site.	Ground water control/surface treatment would likely be required to protect local environment from mobilization of contaminants in ground water during treatment. High probability for agency approval, if shown to be an effective treatment by pilot studies, because it allows for permanent treatment of contaminants.	Surface soils Subsurface soils Ground water

TABLE 6-3

SUMMARY OF TECHNOLOGY SCREENING FOR THE SOUTHERN MARYLAND WOOD TREATING SITE

General Response Action And Associated Remedial Technologies	Retained for Alternative Development	Technical Considerations	Other Considerations	Recommended Application to Site Problem in Remedial Alternative
b. Chemical: Soil flushing	Yes	Developing technology showing success in treatment of PNAs. Low permeabilities of site soils may not present favorable conditions for implementation of this technology. Bench and/or pilot studies would be required. Elutriate stream requires treatment and disposal.	Potential for local environmental threat of contamination from washing fluids during treatment. Surface/ground water control measures may need to implemented to prevent potential ground water contamination. High probability for agency approval, dependent on outcome of pilot studies.	Surface soils Sediments Subsurface soils
c. Physical: In situ adsorption	No	Technology still in early development stages; problems may occur with clogging and saturation of treatment beds. Studies point to probable best application as temporary or short-term remediation technique.	May not meet with regulatory agency approval as a long-term remedial action.	N/A
d. Physical: Supercritical extraction	No	Technology still in early development stages. Sufficient information is not available for preliminary assessment of applicability to Southern Maryland Wood Treating site.	May not meet with regulatory agency approval because it still requires extensive work development.	N/A
e. Thermal: In situ vitrification	Yes	Developing technology which has been tested successfully on large scale (400 to 800 tons) organic waste materials. Vitrified mass expected to have long-term stability. Pilot studies required before implementation.	Could effectively immobilize/ destroy organic and inorganic contaminants. High cost relative to other technologies. High probability for agency approval dependent on outcome of pilot studies.	Surface soils Subsurface soils
6. On-site Treatment				
a. Thermal: Incineration	Yes	Well developed and proven technology. Accepts all materials of organic wastes. Trial burn may be required to determine operating/design parameters. Disposal of ash required.	Removes threat to local environment because contaminants are permanantly destroyed; protection of area from emissions is accomplished using pollution control equipment. Acceptable to regulatory agencies. On-site permits not required under SARA.	Surface soils Sediments Subsurface soils Surface water Ground water Buildings/tanks Tank wastes Dioxins

TABLE 6-3

SUMMARY OF TECHNOLOGY SCREENING FOR THE SOUTHERN MARYLAND WOOD TREATING SITE

General Response Action And Associated Remedial Technologies	Retained for Alternative Development	Technical Considerations	Other Considerations	Recommended Application to Site Problem in Remedial Alternative
b. Thermal: Pyrolysis ● plasma arc ● AER/HTFW reactor	Yes	Developing technology that would require bench and/or pilot testing before implementation. Limited to treatment of aqueous waste streams. Cannot accept sludge type materials.	May not be acceptable as remedial action because of limited applicability. Monitoring and/or controls required for gaseous product. Contaminants are destroyed; gaseous and ash/'char' products are formed.	Surface water
c. Thermal: wet air oxidation	Yes	Demonstrated extensively for industrial applications, limited use for hazardous wastes. Requires bench and/or pilot testing. Use of process limited to pumpable aqueous wastes.	Steam is potential by-product of process. Organics are completely destroyed.	Surface water Ground water Tank wastes Dredging water Washing extract
d. Chemical/Physical: Soil washing/extraciton Hi Cost	Yes	Developing technology utilizing various solutions/washing techniques to extract contaminants from soils/sediments. Bench and/or pilot studies required to determine optimum treatment scheme. Elutriate stream requires treatment and disposal. Some processes utilize conventional equipment from mining industry.	Some processes may be proprietary status. High probability for agency approval, dependent on outcome of bench/pilot studies.	Surface soils Sediments Subsurface soils Tank wastes
e. Physical: Macroencapsulation	No	"Nodule" product exhibits low permeability and good bearing strength; however, leaching can result from presence of free liquid product. May require disposal in secure landfill. Requires laboratory and/or pilot scale testing.	Risks to local public health and environment from potential leaching of contaminants from "nodules". Low probability for regulatory agency approval.	N/A
f. Chemical: Oxidation/reduction	Yes	Currently limited to liquid streams. Not effective for high concentrations of constituents. Dioxins are treatable if extracted in clear liquid. Laboratory/bench and/or pilot testing required.	May be best effective as polishing step for other treatments. Escalating costs for organics at concentrations >100 ppm.	Surface water Ground water Tank wastes Dioxins Dredging water Washing extract
g. Physical: Activated carbon adsorption Polishing	Yes	Commonly used treatment process. Limited to aqueous streams: restricts treatment of streams with < 50 ppm suspended solids and > 10,000 ppm organics. May be problems asso[illegible] with clogging of bed due to hi[illegible]	May produce large amounts of spent carbon with concentrated contaminants which requires disposal and/or treatment.	Surface water Ground water Dredging water Washing extract

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TABLE 6-3

SUMMARY OF TECHNOLOGY SCREENING FOR THE SOUTHERN MARYLAND WOOD TREATING SITE

General Response Action And Associated Remedial Technologies	Retained for Alternative Development	Technical Considerations	Other Considerations	Recommended Application to Site Problem in Remedial Alternative
h. Physical: Ion exchange	No	Similar to carbon adsorption but restricts treatment of streams with > 50 ppm suspended solids and > 2,500 ppm organics. May be problems associated with clogging and regeneration of large amounts of resin material. Bench and/or ilot studies required.	High costs associated with regeneration of large amounts of resin material.	N/A
i. Physical: Membrane separation	No	Limited to treatment of aqueous streams with organic concentrations in mg/l range. Clogging of membrane can occur from high concentrations of solids and/or organics. Laboratory and/or pilot testing required to confirm feasibility and determine membrane compatibility.	Concentrated solutions must be disposed of; effluent stream concentrations are in 10 to 100 ug/l range, which mav be above acceptable levels.	N/A
j. Biological: Land Farming/Composting	Yes	Developing technology that has been used successfully on treatment of organics including aromatic hydrocarbons. Requires bench and/or pilot testing prior to implementation. High levels of organics may be toxic to microrganisms.	Surface and/or groundwater controls would likely be required to protect local environment from mobilization of contaminants into the shallow aquifer. High probability for agency approval, dependent on outcome of pilot work.	Surface soils Sediments Subsurface soils Tank wastes
k. Biological: Aerobic treatment	Yes	Has been used successfully for treatment of various organics. Carbon can be used as catalyst to treat wider spectrum of organics. Sensitive process; warrents careful control of operating conditions. Limited to aqueous streams and low levels of organics. Laboratory and/or pilot testing required.	Monitoring/ control of volatile organic emissions required. Highly contaminated sludge and/or carbon by-product requires disposal. Contaminants are detoxified or decomposed, removing or decreasing health and environmental effects.	Surface water Ground water Dredging water Washing extract
l. Biological: Anaerobic treatment	Yes	Can handle higher concentrations of organics compared to aerobic but are more sensitive to stream characteristic changes. Has not been applied to CERCLA waste streams on a frequent basis. Bench- and/or pilot-scale testing required.	Monitoring required for methane gas by-product, which can be recovered as an energy resource. Contaminants are reduced to methane and carbon dioxide.	Surface water Ground water Dredging water Washing extract

TABLE 6-3

SUMMARY OF TECHNOLOGY SCREENING FOR THE SOUTHERN MARYLAND WOOD TREATING SITE

General Response Action And Associated Remedial Technologies	Retained for Alternative Development	Technical Considerations	Other Considerations	Recommended Application to Site Problem in Remedial Alternative
a. Solidification/ stabilization problems w/ organics - can use "micro" encapsulation	Yes	Immobilization of organic contaminants. Bench- and/or pilot-scale testing required to determine optimum treatment process. Some processes result in volume reduction of treated materials. It is most cost-effective to dispose of solidified product on-site.	Can effectively immobilize contaminants. Probability for agency approval, dependent on outcome of pilot studies. Product can potentially be listed as non-hazardous after passing leachability tests. would be required	Surface soils Sediments Subsurface soils Tank wastes
7. Off-Site Treatment a. Thermal: Incineration	Yes	Well developed, proven, and commercially available technology; accepts all materials: organic wastes. Commercial incinerator capacity is limited. May not accept high volumes. It may be time consuming to treat due to low BTU values.	Contaminants are removed from site and are permanently destroyed; U.S. DOT requirements for shipment of hazardous waste must be met. Some soils/sediments may require stabilization prior to disposal. Acceptable to regulatory agencies. High cost to burn low BTU soils. Commercial facilities not set-up to handle bulk loads. May have problems locating a permitted facility to treat dioxins.	Surface soils Sediments Subsurface soils Tank wastes Dioxins
8. Off-Site Disposal	Yes	This technology involves excavation of contaminated materials and transport to approved off-site disposal sites. Commercial RCRA landfill capacity is limited and high volumes may not be accepted.	Materials are not treated or destroyed but the threat to the local environment is eliminated by removing the contaminated materials to a secure site. A RCRA approved landfill must be used. U.S. DOT requirements for shipment of hazardous waste must be met.	Surface soils Sediments Subsurface soils Tank wastes
9. On-Site Disposal	Yes	This technology involves excavation of contaminated materials followed by disposal in an on-site newly constructed RCRA-approved landfill. Incorporates proven techniques and would include surface management and infiltration control. Site characteristics may warrent construction of an above ground vault-type landfill.	Favorable impact to public health and environment due to securement of contaminated materials. RCRA approval is required. There may be problems gaining approval for on-site disposal of dioxins. There may be problems due to dust/odor from excavation activities.	Surface soils Sediments Subsurface soils Tank wastes Buildings/tanks Dioxins

- Low - No action with security upgrade and monitoring
- Support - Regrading, revegetation, and diversion
- Support - Sedimentation basins and ponds
- Synthetic membrane cap
- Low permeability soils cap
- Asphalt cap
- Multilayer cover system
- Ground water containment
- Interception trenches/ditches, and drains
- Ground water pumping
- Complete or partial removal
- In situ biodegradation/bioreclamation
- In situ soil flushing
- In situ vitrification
- On-site incineration
- On-site pyrolysis
- Wet air oxidation
- On-site soil washing
- On-site chemical oxidation/reduction
- support On-site activated carbon adsorption
- On-site land farming/composting
- On-site aerobic/anaerobic biological treatment
- On-site solidification/stabilization
- Off-site incineration - tanks
- Off-site disposal - limited
- On-site disposal

The technologies listed will be combined for the development of remedial alternatives following completion of Phase III of the RI.

7.0 EVALUATION OF REMEDIAL ACTION ALTERNATIVES

Reserved

8.0 SUMMARY OF EVALUATION

Reserved

9.0 RECOMMENDATIONS AND CONCLUSIONS

The following conclusions may be summarized from the data and information available at the completion of Phase II of the RI.

- The concentrations of HSL volatile organics, pentachlorophenol, and PNAs were below the method detection limits in all TWA air samples except the sample collected near the tanks in the northeast area of the site. This sample was found to contain naphthalene at a concentration of 0.003 mg/m^3 in air.

- Surface water bodies on and near the site (freshwater pond, west tributary, east tributary) receive water from the on-site groundwater. Samples of surface water from the freshwater pond and the west tributary contained volatile organics, PNAs, pentachlorophenol, and other semivolatile compounds up to 1,900 feet downstream of the pond. Total PNA concentrations were as high as 238 ug/L in surface water. Analytical results of samples of surface water from the east tributary for volatile organics, PNAs, and PCP were below the method detection limit.

- Sediment samples from the freshwater pond and west tributary were found to contain PNAs as far downstream from the site as 7,125 feet. This sample contained an estimated 41 ug/kg of fluoranthene. At the confluence of the east and west tributaries (1900 ft downstream of the freshwater pond) the total PNA concentration in sediments was 10,800 ug/kg. Sediment samples from the east tributary were found to contain PNAs near the site (sample location U02, approximately 100 ft from the site fence) and near the confluence of the east and west tributaries. Total PNA concentrations in sediments along the east tributary ranged from non-detectable to 2,110 ug/kg.

- Approximately 11,960 gallons of dioxin contaminated wastes are contained in tanks on the site. Another 2,140 gallons of tanked waste contain no dioxins but do contain volatile organic compounds and/or PNAs.

- Shallow ground water contamination on-site appears to be localized to an area bounded by the process area, the freshwater pond, and the area to the east of the excavated lagoons. The groundwater contaminants tend to be PNAs and acid extractable organics (phenol and cresols). Most of the organic compounds detected in the shallow groundwater are either soluble or heavier than water. Floating organic contaminants may be present, but the concentration ranges of these contaminants are low relative to the soluble and sinking organic contaminants. As can be seen in Table 9-1, some of these compounds were detected in ground water at concentrations in excess of their solubilities, indicating that oily materials found in groundwater in this area are increasing the contaminant holding capacity of the groundwater.

- As depicted in Table 9-1, the compounds with the highest solubilities in water (i.e. phenol, 2,4-dimethylphenol, naphthalene, fluoranthene, pyrene, acenaphthylene, acenaphthene) were the compounds found most frequently in groundwater and surface water.

  These high solubility compounds were found in subsurface soils in greater frequences and concentrations than in surface soils. This supports the conclusion that these compounds are migrating downward through the soils and traveling with the groundwater.

- The lower solubility compounds, such as benzo (a) anthracene and benzo (a) pyrene, are found with greater frequency and in higher concentrations in surface soils and sediments than in subsurface soils. This supports the conclusion that surface runoff/erosion is an important migratory pathway for site contaminants.

- Stained soils were encountered in the saturated soils just above the clay layer in the area where the highest groundwater contamination concentrations were found. A soil sample including this stain was found to contain PNAs concentrations 2,300,000 ug/kg and pentachlorophenol concentrations greater than 36,000 ug/kg.

- Organic contamination in surface soils does not follow any specific pattern and does not appear limited to any specific area. These results are consistent with the operating history and remedial activities that have occurred at the site.

- No tetrachlorodibenzo dioxins were found in any of the samples analyzed for dioxins. Most of the dioxins and furans found in site soils, sediments, tank wastes, surface waters, and groundwater were the less toxic octa- and hepta- chlorinated congeners.

TABLE 9-1

COMPARISON OF CONTAMINANT SOLUBILITY WITH FREQUENCY OF OCCURENCE FOR SMT SITE

SAMPLE MATRIX			SHALLOW GROUND WATER			SURFACE WATER			TANK			SURFACE SOILS			SUBSURFACE SOILS			SEDIMENTS		
TOTAL NO. OF SAMPLES			17			14			9			13			19			16		
	Molecular Weight	Solubility In Water (25C) ug/L	NUMBER OF TIMES DETECTED	FREQUENCY (%)	CONCENTRATION RANGE(ppb)	NUMBER OF TIMES DETECTED	FREQUENCY (%)	CONCENTRATION RANGE(ppb)	NUMBER OF TIMES DETECTED	FREQUENCY (%)	CONCENTRATION RANGE(ppb)	NUMBER OF TIMES DETECTED	FREQUENCY (%)	CONCENTRATION RANGE(ppb)	NUMBER OF TIMES DETECTED	FREQUENCY (%)	CONCENTRATION RANGE(ppb)	NUMBER OF TIMES DETECTED	FREQUENCY (%)	CONCENTRATION RANGE(ppb)
Phenol	94.11	67,000,000	9	53	ND-11,000	3	21	ND-5	0	0		0	0		2	11		0	0	
2-Methylphenol	108.2	(1)	6	35	ND-14,000	1	7		0	0		0	0		0	0		0	0	
4-Methylphenol	108.2	(1)	4	24	ND-16,000	1	7		0	0		0	0		1	5		0	0	
2,4-Dimethylphenol	122.2	17,000,000	7	41	ND--8,300	2	14	ND-47	0	0		0	0		2	11		0	0	
Naphthalene	128.2	34,400	5	29	ND-40,000	0	0		3	33	ND-8,800,000	1	8		6	32	ND-2,300,000	2	13	
2-Methylnaphthalene	142.2	N/A	6	35	ND-9,300	0	0		4	44	ND-5,700,000	1	8		5	26	ND-580,000	4	25	
2-Chloronaphthalene	162.6	6,740	0	0		0	0		0	0		0	0		0	0		0	0	
Acenaphthylene	152.2	3,930	6	35	ND-550	0	0		2	22		2	15		2	11		6	38	
Acenaphthene	154.2	3,420	6	35	ND-12,000	1	7		0	0		1	8		5	26	ND-540,000	5	31	
Fluorene	166.2	1,980	7	41	ND-8,600	2	14	ND-29	3	33	ND-8,500,000	1	8		5	26	ND-440,000	7	44	ND-5,700
Phenanthrene	178.2	1,290	6	35	ND-13,000	1	7		1	11		2	15		6	32	ND-900,000(b)	10	63	ND-18,000
Anthracene	178.2	73	0	0		0	0		2	22		1	8		3	16		3	19	
Fluoranthene	202.3	260	9	53	ND-14,000	3	21	ND-71	2	22		3	23	ND--170,000	5	26	ND-820,000	11	69	ND-21,000
Pyrene	202	140	6	35	ND-5,700	2	14	ND-30	0	0		4	31	ND-3,600	5	26	ND-240,000	10	63	ND-15,800
Benzo(a)Anthracene	228.3	14	2	12		1	7		2	22		3	23	ND-160,000(a)	4	21		9	56	ND-9,500(a)
Chrysene	228.3	2	0	0		0	0		2	22		1	8		3	16		5	31	
Benzo(b)Fluoranthene	252.3	N/A	0	0		0	0		0	0		1	8		3	16		4	25	
Benzo(k)Fluoranthene	252.3	N/A	2	12		1	7		0	0		2	15		5	26	ND--61,000	8	50	ND-7,500(c)
Benzo(a)Pyrene	252.3	3.8	2	12		1	7		0	0		3	23	ND-30,000	3	16		7	44	
Indeno(1,2,3-cd)Pyrene	276.3	N/A	1	6		0	0		0	0		2	15		1	5		5	31	ND-2,100
Dibenzo(a,h)Anthracene	278.4	0.5	0	0		0	0		0	0		0	0		0	0		0	0	
Benzo(g,h,i)Perylene	276	0.26	1	6		0	0		0	0		0	0		0	0		1	6	

NOTES

N/A= Not Available

(1)= Solubility at 40C 24,000,000 - 31,000,000 ug/L.

(a) Unable to differentiate between Benzo(a)Anthracene and Chrysene.

(b) Unable to differentiate between Phenanthrene and Anthracene.

(c) Unable to differentiate between Benzo(b)Fluoranthene and Benzo(k)Fluoranthene.

- The UV fluorescence field screening for PNAs was useful in developing soil volume estimates based on an order-of-magnitude relationship between screening and conventional analytical methods. The UV fluorescence screening method was especially useful in identifying samples with non-detectable levels of PNAs.

- No contaminants were detected in residential well samples.

Based on the information available at the present time, the following recommendations are proposed to support conclusion of the public health evaluation/risk assessment and the feasibility study for the SMWT site. These items would involve additional field investigation and technical activities as outlined below.

- A second round of shallow groundwater sampling to confirm the results of the previous sampling; specifically, that the only area of significant shallow groundwater contamination is confined to the area bounded by the process area, the excavated lagoons, and the freshwater pond. This data would be utilized in the risk assessment and to site additional shallow wells as discussed below.

- Installation of additional shallow wells to evaluate ground water quality and flow directions. The locations of these wells are depicted in Figure 9-1. One well would be located approximately 200 feet to the west of the freshwater pond. A second well would be installed approximately 30 feet west of site boundary to the west of the excavated lagoons. This well will be used to define the groundwater flow contours in this area. These wells will be used to better characterize the ground water flow and direction and quality west and northwest of the freshwater pond. In addition, the second well will be used to ensure that contaminant flow is not migrating past the pond towards the residences to the west of the site. A third well would be located immediately south of the seepage area downstream of the freshwater pond. This well would be used to determine whether contaminants are bypassing the seepage area to enter the west tributary further downstream. Additional shallow wells may be needed based on the results of the second round of groundwater sampling.

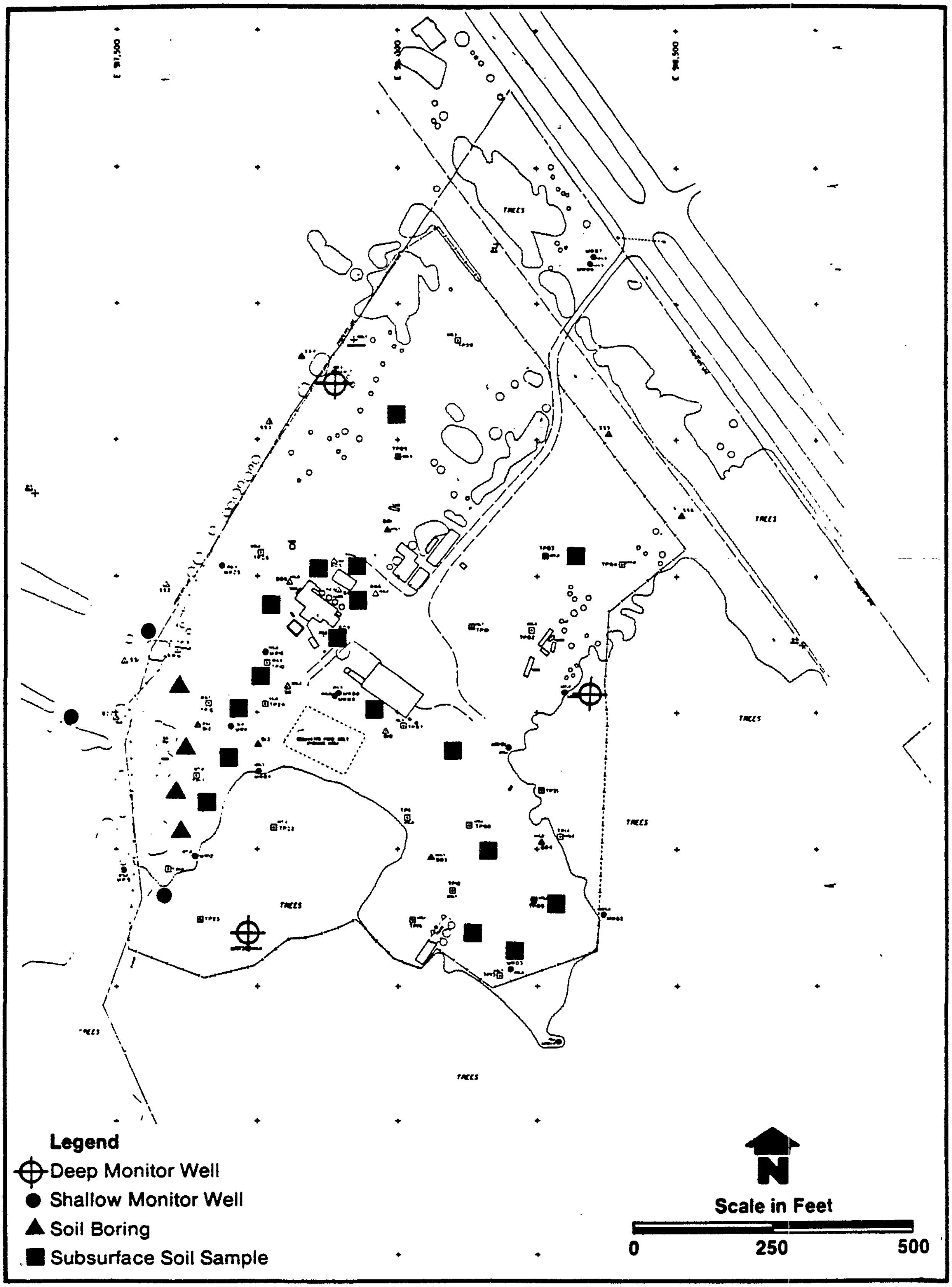

FIGURE 9-1 PROPOSED ADDITIONAL SAMPLING AND MONITOR WELL LOCATIONS

- Installation of up to three deeper wells (approximately 100 ft) to evaluate the properties (including continuity and thickness) of the silt and clay layer below the shallow water table aquifer and to determine the potential for contamination of deeper water bearing zones below this clay layer.

  The study of the continuity of this silt and clay layer is important to determine whether this layer can be used as an effective aquiclude in ground water enclosure schemes (i.e., slurry walls).

  The deeper water bearing zones are important for water use in St. Mary's County, and should be investigated to support the risk assessment. These wells, which are depicted in Figure 9-1, would be located near existing shallow wells to provide a comparison of piezometric head. This comparison provides insight into the direction of leakage between the water table and the deeper water bearing zones. In addition, these wells would be used to establish ground water flow directions in the water bearing zones below the clay layer.

- Sampling of all newly constructed monitor wells and selected RI Phase II wells.

- Installation of up to four shallow soil borings for the purposes of collecting samples for additional geotechnical analysis. Soil strength and cohesion data is needed to establish the technical feasibility and construction and maintenance details for interceptor trenches and slurry walls. These boring locations are depicted in Figure 9-1.

- Sampling of subsurface soils for dioxins and furans. The presence of dioxins and furans in surface soils, coupled with the presence of the layer of stained soils in the saturated soils justify evaluation of subsurface soils for dioxins and furans. Proposed sample locations are depicted in Figure 9-1. Additional samples could be collected from the soil borings.

- Collection of wipe samples from the on-site process buildings and analysis for dioxins and furans. The presence or absence of dioxins and furans will be a significant factor in evaluating remedial alternatives for buildings.

- Sampling of selected wells for dioxins and furans. The results of the dioxin analyses from monitor well MW-11 were inconclusive due to matrix problems during analysis. Resampling of this well and selected additional wells to determine the dioxin and furan concentrations in both the aqueous and oil phase is justified.

- Completion of the risk assessment to define the action levels for soil sediment, ground water, and surface water remediation. Treatment volume and cost estimates can then be revised.

- Completion of bench and/or pilot scale testing of the in situ biodegradation/bioreclamation remedial option. This testing should include the evaluation of the technical feasibility of this option as it applies to the site contaminants and conditions. The results of the bench scale testing should be the general operating parameters (i.e., nutrient, oxygen, capital equipment requirements) necessary to perform a pilot study if applicable. Column leaching tests should also be performed to evaluate surfactant options, and injection and recovery systems.

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